02-24-05

1 FW AF 3679

PTO/SB/21 (09-04)
Approved for use through 07/31/2006. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Total Number of Pages in This Submission: 72

Application Number	10/036,105
Filing Date	10/17/2001
First Named Inventor	Schultz
Art Unit	3679
Examiner Name	Collins, Giovanna M.
Attorney Docket Number	SC-01-05

ENCLOSURES *(Check all that apply)*

- [x] Fee Transmittal Form
- [x] Fee Attached
- [ ] Amendment/Reply
  - [ ] After Final
  - [ ] Affidavits/declaration(s)
- [ ] Extension of Time Request
- [ ] Express Abandonment Request
- [ ] Information Disclosure Statement
- [ ] Certified Copy of Priority Document(s)
- [ ] Reply to Missing Parts/ Incomplete Application
  - [ ] Reply to Missing Parts under 37 CFR 1.52 or 1.53
- [ ] Drawing(s)
- [ ] Licensing-related Papers
- [ ] Petition
- [ ] Petition to Convert to a Provisional Application
- [ ] Power of Attorney, Revocation Change of Correspondence Address
- [ ] Terminal Disclaimer
- [ ] Request for Refund
- [ ] CD, Number of CD(s) _____
  - [ ] Landscape Table on CD
- [ ] After Allowance Communication to TC
- [ ] Appeal Communication to Board of Appeals and Interferences
- [x] Appeal Communication to TC **(Appeal Notice, Brief, Reply Brief)**
- [ ] Proprietary Information
- [ ] Status Letter
- [x] Other Enclosure(s) (please Identify below):

Remarks

(3) bound and (1) unbound copy of Appeal Brief include Drawings and Notice of Appeal as Appendices

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Name	Groover & Holmes		
Signature			
Printed name	Patrick C.R. Holmes		
Date	02/23/2005	Reg. No.	46,380

CERTIFICATE OF TRANSMISSION/MAILING

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Signature			
Typed or printed name	Peggy Heath	Date	02/23/2005

PTO/SB/17 (12-04v2)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Effective on 12/08/2004.
Fees pursuant to the Consolidated Appropriations Act, 2005 (H.R. 4818).

FEE TRANSMITTAL
For FY 2005

☐ Applicant claims small entity status. See 37 CFR 1.27

TOTAL AMOUNT OF PAYMENT ($) 500.00

Complete if Known	
Application Number	10/036,105
Filing Date	10/17/2001
First Named Inventor	Schultz
Examiner Name	Collins, Giovanna M.
Art Unit	3679
Attorney Docket No.	SC-01-05

METHOD OF PAYMENT (check all that apply)

☑ Check ☐ Credit Card ☐ Money Order ☐ None ☐ Other (please identify): _____

☑ Deposit Account Deposit Account Number: 07-2320 Deposit Account Name: Groover & Holmes

For the above-identified deposit account, the Director is hereby authorized to: (check all that apply)

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FEE CALCULATION

1. BASIC FILING, SEARCH, AND EXAMINATION FEES

Application Type	FILING FEES Fee ($)	FILING FEES Small Entity Fee ($)	SEARCH FEES Fee ($)	SEARCH FEES Small Entity Fee ($)	EXAMINATION FEES Fee ($)	EXAMINATION FEES Small Entity Fee ($)	Fees Paid ($)
Utility	300	150	500	250	200	100	
Design	200	100	100	50	130	65	
Plant	200	100	300	150	160	80	
Reissue	300	150	500	250	600	300	
Provisional	200	100	0	0	0	0	

2. EXCESS CLAIM FEES

Fee Description	Fee ($)	Small Entity Fee ($)
Each claim over 20 (including Reissues)	50	25
Each independent claim over 3 (including Reissues)	200	100
Multiple dependent claims	360	180

Total Claims	Extra Claims	Fee ($)	Fee Paid ($)
_____ - 20 or HP =	_____	x _____	= _____

HP = highest number of total claims paid for, if greater than 20.

Indep. Claims	Extra Claims	Fee ($)	Fee Paid ($)
_____ - 3 or HP =	_____	x _____	= _____

HP = highest number of independent claims paid for, if greater than 3.

Multiple Dependent Claims Fee ($)	Fee Paid ($)
_____	_____

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper (excluding electronically filed sequence or computer listings under 37 CFR 1.52(e)), the application size fee due is $250 ($125 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

Total Sheets	Extra Sheets	Number of each additional 50 or fraction thereof	Fee ($)	Fee Paid ($)
_____ - 100 =	_____ / 50 =	_____ (round up to a whole number)	x _____	= _____

4. OTHER FEE(S)

	Fees Paid ($)
Non-English Specification, $130 fee (no small entity discount)	
Other (e.g., late filing surcharge): Appeal Brief	500.00

SUBMITTED BY

Signature	[signature]	Registration No. (Attorney/Agent) 46,380	Telephone 972-980-5840
Name (Print/Type)	Patrick C.R. Holmes		Date 02/23/2005

In the United States Patent and Trademark Office

In re application of:	:
Schultz et al.	: Art Unit: 3679
AN 10/036,105	: Examiner: Collins, Giovanna M.
Filed: 10/17/2001	: Atty's Docket: SC-01-05

For: Method and Apparatus for Monitoring the Condition of a Downhole Drill Bit, and Communicating the Condition to the Surface (confirmation no. 4527)

APPEAL BRIEF

Honorable Commissioner of Patents and Trademarks
Alexandria, VA 22313

Sir:

Appellant herewith respectfully submits that Examiner Collins's decision of 09/23/2004, finally rejecting claims 14 and 16-18 and objecting to claim 15, should be reversed in view of the following arguments and authorities.

Table of Contents

Real Party in Interest

The real party in interest, and assignee of this case, is Halliburton Energy Services, Inc.

Related Appeals and Interferences

To the best knowledge and belief of the undersigned attorney, there are no related appeals or interferences.

Status of Claims

Claims 1-13 are allowed. Claims 14 and 16-18 are pending and are each under final rejection. Claim 15 is objected to. No other claims are pending.

Status of Amendments after Final

An amendment after final rejection, which was filed on October 27, 2004, has been entered.

Summary of Invention

The following summary refers to disclosed embodiments and their advantages, but does not delimit any of the claimed inventions.

The present application describes a reliable, inexpensive means of early detection and operator warning when there is a roller cone drill bit failure. (Page 2, lines 10-12.) This system is technically and economically suitable for use in low cost rotary land rig drilling operations as well as high-end offshore drilling. (Page 2, lines 12-14.) The solution is able to detect impending bit failure prior to catastrophic damage to the bit, but well after the majority of the bit life is expended. (Page 2, lines 14-16.) In addition to failure detection, the innovative system is able to alert the operator at the surface once an impending bit failure is detected. (Page 2, lines 16-18.)

Figure 1 shows the physical arrangement of apparatus relative to the bit. (Page 20, lines 26-27.) The drill pipe 102 connects to the instrumented sub assembly 104, which contains the sensors 106 and telemetry apparatus for relaying a failure signal to the surface. (Page 20, line 27–Page 21, line 1.) The sub assembly is connected to the drill bit 108 through a threaded connection 110. (Page 21, lines 3-4.)

The first class of embodiments discussed for detecting impending bit failure has been named the

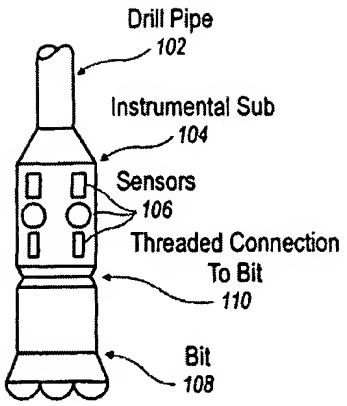

FIG. 1

Spectral Power Ratio Analysis (SPRA) method. (Page 21, lines 8-10.) Figure 2 illustrates the process. (Page 21, line 10.)

Figure 2 shows an overview of the process by which failure is detected and indicated to the operator in this class of embodiments. (Page 21, lines 11-12.) The sensors in the drill assembly include circuitry that performs a fast Fourier transform on the data (step 202) to thereby translate the data into the frequency domain. (Page 21, lines 12-15.) A spectral power comparison is then performed (step 204) which allows the data to be put into spectral power ratios. (Page 21, lines 15-17.) A failure detection algorithm checks to see if the failure condition(s) is (are) met. (Page 21, lines 17-18.) If a failure is indicated, the telemetry system relays the failure indication signal to the surface operator (step 208). (Page 21, lines 18-20.)

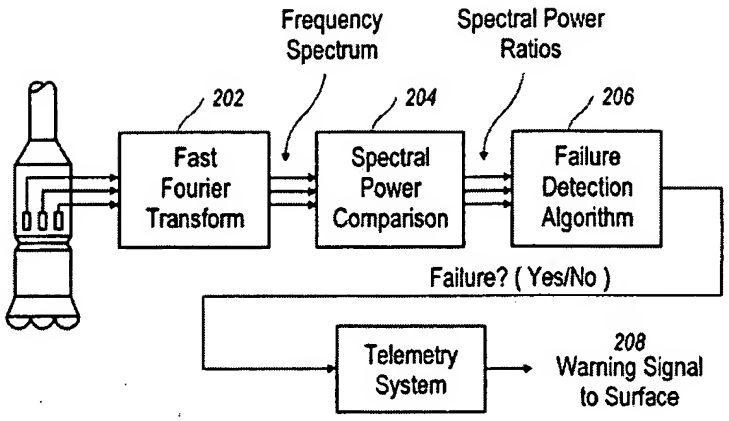

FIG. 2

In this method sensor data is collected in blocks and then analyzed in the frequency domain. (Page 21, lines 21-22.) The frequency spectrum of a window of fictitious sensor data is broken up into bands. (Page 21, lines 22-24.) The idea is that when the bearings in a bit are in good mechanical shape most of the spectral energy found in the bit vibration is contained in the lowest frequency band. (Page 22, lines 13-15.) As a bearing starts to fail it produces a greater level of vibration in the higher frequency bands. (Page 22, lines 15-16.)

The second class of embodiments demonstrating innovations of the present application is herein referred to as the Mean Strain Ratio Analysis (MSRA) method. (Page 27, lines 19-21.) In an exemplary embodiment, method strain measurements taken from an instrumented sub directly above the bit are used to detect

changes in induced bending and axial stresses which are related to a roller cone bearing failure. (Page 27, lines 24-27.)

Figures 16A and 16B show a drill string with a sub assembly 1602 and drill bit 1604. (Page 28, lines 4-5 and Amendment in Response to Office Action dated 11/20/2002, Page 5 ***(no line numbers in Amendment.)***) The cross sectional view (along I_I) shows the placement of strain gauges 1606, here shown as symmetrically distributed around the sub 1602. (Page 28, lines 5-7.) Of course, the strain gauges 1606 need not be symmetrically placed, since failures are detected by relative changes in the readings. (Page 28, lines 7-9.)

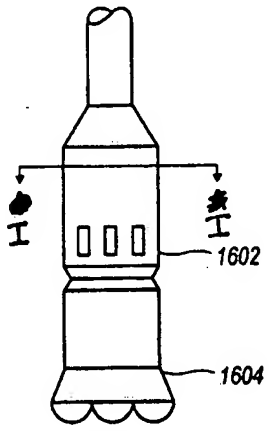

Fig. 16A

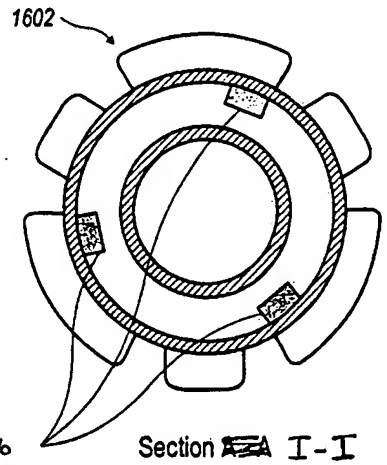

Fig. 16B

There is an average percentage of the total load on the bit that each of the cones on a roller cone bit will support. (Page 28, lines 10-11.) When a bit is new (i.e., no bearing failure), the average amount of strain measured by each strain gauge in Figures 16A and

16B will maintain a fairly constant percentage of the average strain in each of the other strain gauges. (Page 28, lines 21-25 and Amendment in Response to Office Action dated 11/20/2002, Page 5 ***(no line numbers in Amendment.)***) In other words, if an average value of strain for each of the strain gauges is computed, then divided by a similar average strain value for each of the other strain gauges, this ratio will remain fairly constant, even if the load on the bit is varied. (Page 28, lines 25-28.) However, when the percentage of the load changes as an individual cone wears faster than the other cones or suffers dramatic bearing wear, the ratio of the average strain at each of the strain gauge locations will change. (Page 28, line 28–Page 29, line 2.)

A flow showing an example of the MSRA detection scheme is shown in Figure 18. (Page 29, lines 21-22.) In this embodiment, the strain gauges send data to a low pass filter, which filters the sensor signals (step 1802) and passes the result to circuitry which computes the mean strain ratios (step 1804). (Page 29, lines 22-25.) These are used by the failure detection algorithm to detect a bit failure (step 1806). (Page 29, line 25–Page 30, line 1.) If a failure is detected, the telemetry system sends a warning signal to the surface (step 1808). (Page 30, lines 1-2.)

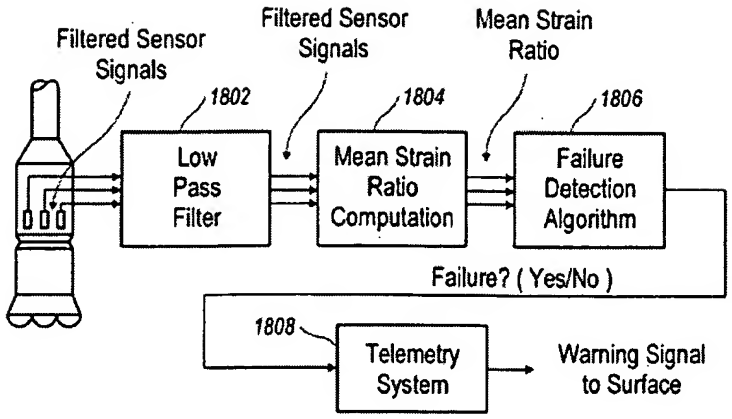

FIG.1 8

The third class of embodiments for detecting impending bit failure is herein referred to as the Adaptive Filter Prediction Analysis (AFPA) method. (Page 33, lines 23-25.) In this method an adaptive filter (preferably an adaptive neural network) is used to process sensor signals as part of an overall scheme to detect drill bit failure. (Page 33, lines 25-27.)

Figure 32 shows a schematic of an example embodiment. (Page 34, line 2.) Sensor signals from the instrumented sub are received by the adaptive filter, which uses past signal measurements to predict the next sensor value (step 3202). (Page 34, lines 3-5.) The adaptive filter (preferably a neural net) attempts to predict sensor readings one step ahead in time using older sensor readings (step 3204). (Page 34, lines 5-7.) The resulting prediction error statistics are analyzed by the failure detection algorithm for failure (step 3206), and if a failure is detected, the telemetry

system sends a warning signal to the surface (step 3208). (Page 34, lines 7-10.)

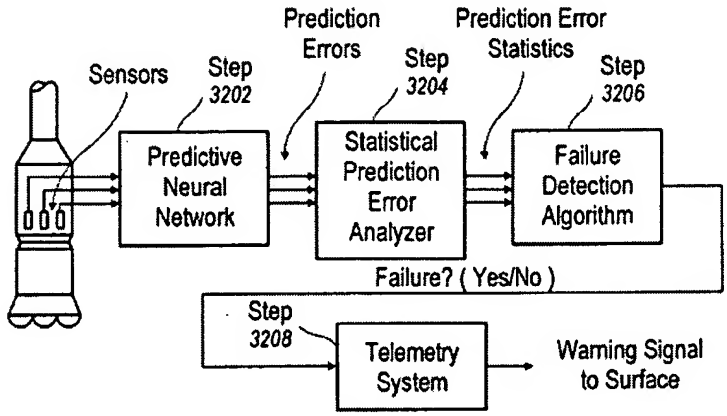

FIG. 32

Test data has shown that when a bearing in a cone starts to fail, it will generally emit bursts of high-frequency vibration or will cause the cone to lockup. (Page 35, lines 9-11.) Either of these occurrences will cause an abrupt and unpredictable change in the pattern of vibrations produced by the bit. (Page 35, lines 11-13.) If the prediction error of an adaptive filter that is being used to predict bit vibration is monitored, momentary increases in the prediction error will be observed. (Page 35, lines 13-15.) These observations can be used to detect roller cone bit failure. (Page 35, lines 15-16.)

A method and apparatus for signaling the operator at the surface is described. (Page 39, line 28–Page 40, line 1.) In the example embodiment of Figure 46, the basic detection/warning

system operation follows a sequence. (Page 40, lines 15-16.) First the sensor data is monitored while the drilling operation proceeds. (Page 40, lines 16-17.) The detection method previously described is used to detect a failure in progress. (Page 40, lines 17-18.) If a failure is detected, a port is opened which causes a drop in the surface pump pressure. (Page 40, lines 18-20.) This drop in pressure can easily be seen by the surface operator, serving as a warning that a failure is in progress in the bit. (Page 40, lines 20-21.)

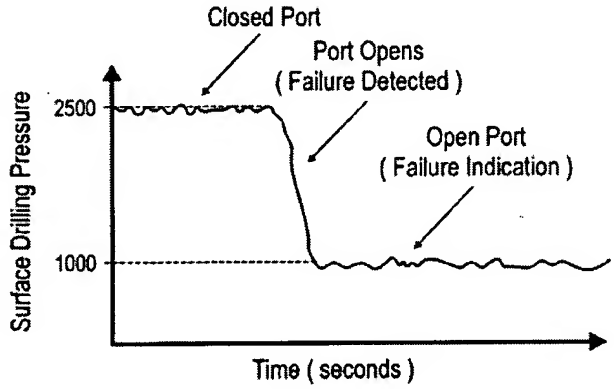

Fig.4 6

A schematic of the downhole tool apparatus is shown in Figure 47. (Page 40, line 22.) The workstring 4702 contains a fluid passage, which allows fluid to reach the drill bit 4704, passing through the instrumented sub 4706. (Page 40, lines 23-24.) The sub 4706 includes a fluid bypass port 4708 and a sleeve 4710 or valve which opens or closes the fluid bypass port 4708. (Page 40, lines 25-26.) An actuator 4712 is connected to both the sleeve 4710 and

the detection electronics 4714. (Page 40, lines 26-28.) Sensors 4716 are also located in the sub 4706 (in this embodiment). (Page 40, lines 28-29.)

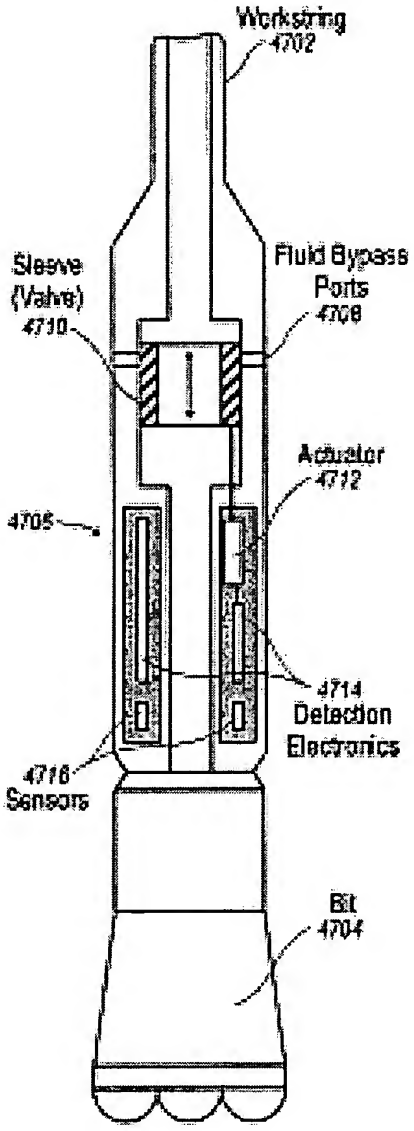

Fig. 47

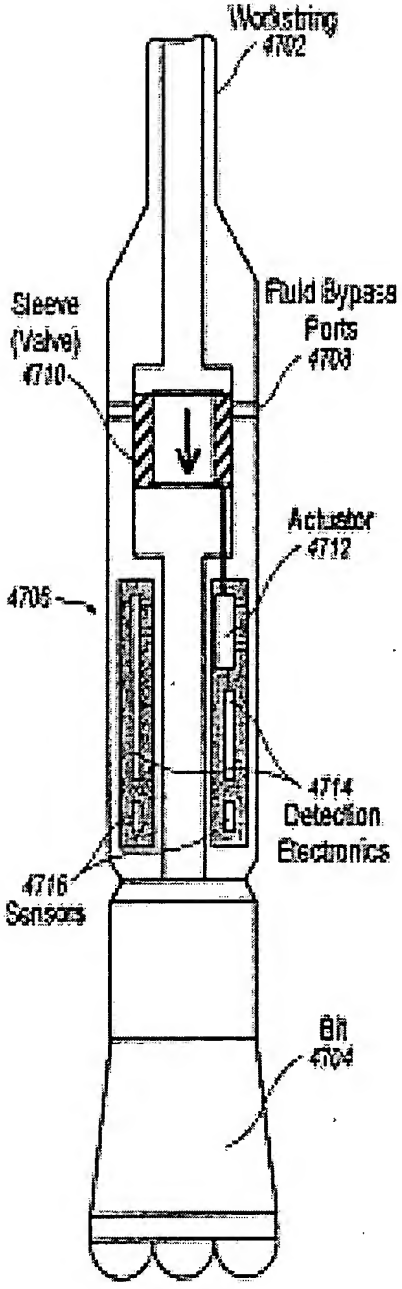
Workstring
4702
Sleeve
(Valve)
4710
Fluid Bypass
Ports
4708
Actuator
4712
4706
4714
Detection
Electronics
4716
Sensors
Bit
4704

Fig. 61

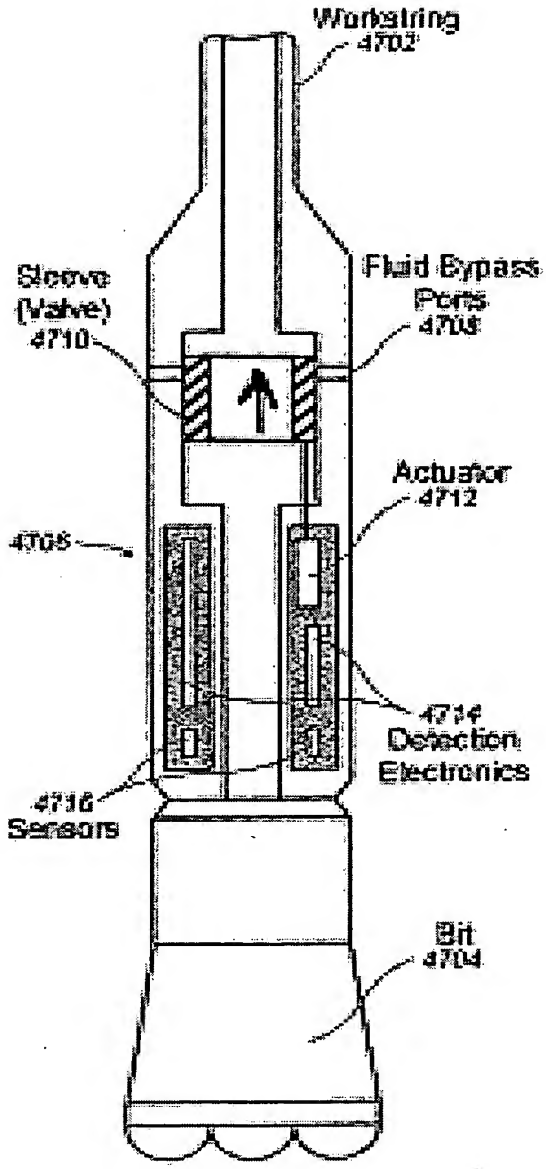

Fig. 47

In one embodiment a sleeve valve can be opened and closed repeatedly to cause corresponding low and high pressure pumping pressure levels at the surface. (Page 41, lines 1-3.) In another embodiment a "one-shot" pilot valve is used to initiate a fluid

metering system which lets the sleeve valve slowly meter into the open position, then continue into the closed position for normal drilling to resume. (Page 41, lines 11-14.)

Issues

Issue 1 – Whether claims 14 and 16-17 are anticipated under 35 U.S.C. § 102 (b) by U.S. Patent No. 4,866,680 to Scherbatskoy (hereinafter "Scherbatskoy").

Issue 2 – Whether claim 18 is obvious under 35 U.S.C. § 103 over Scherbatskoy in view of U.S. Patent No. 5,511,037 to Randall et al. (hereinafter "Randall").

Issue 3 – Whether every element of claim 15 is shown in the Figures.

Grouping of Claims

For each ground of rejection that applies to more than one claim, such claims, to the extent identified and argued below, do not stand or fall together.

Argument

I. Whether claims 14 and 16-17 are anticipated under 35 U.S.C. § 102 (b) by U.S. Patent No. 4,866,680 to Scherbatskoy (hereinafter "Scherbatskoy")?

A. Claim 14 Is Not Anticipated by Scherbatskoy

A claim is anticipated only if a single prior art reference teaches each and every element of the claim (MPEP 2131). Independent claim 14 recites:

> A method of operating a drill rig, comprising the steps of: using downhole circuitry to signal a change in downhole equipment condition by causing a reduction in drilling fluid long-time average pressure.

Scherbatskoy fails to teach the limitation in claim 14 of "using downhole circuitry to signal a change in downhole equipment condition...." Scherbatskoy generally pertains to measurements while drilling a bore hole in the earth. [Col. 1, lines 24-26.] More specifically, Scherbatskoy is directed toward an improvement in the actual signaling method which employs signal discrimination and which can thereby increase the amount of data which can be transmitted to the earth's surface. [Col. 6, lines 7-13.]

However, Appellants respectfully submit that Scherbatskoy is not concerned with indicating downhole equipment condition, but rather teaches that information concerning the earth's subsurface can be transmitted to the earth's surface. For example, in an

embodiment, Scherbatskoy discloses that a mud valve is operated by the output of "one or more sensors for sensing one or more downhole parameters in the earth's subsurface near the drill bit." This passage states:

> The valve, in accordance with my invention, is operated by the output of one or more sensors for sensing one or more downhole parameters in the earth's subsurface near the drill bit....
>
> [Col. 6, lines 14-17, emphasis added.]

Further, Scherbatskoy provides the following examples of sensors that generate electric signals indicative of such downhole parameters: gamma ray sensors, temperature sensors, pressure sensors, gas content sensors, magnetic compasses, strain gauge inclinometers, magnetometers, gyro compasses, and many others. [Col. 13, lines 6-11] However, Appellant finds no passage in Scherbatskoy where these sensors are characterized as indicating condition of downhole equipment. Examiner also has not cited any passage which states that these sensors are used to indicate condition of downhole equipment.

Examiner addresses this deficiency in the Examiner's argument in the Advisory Action which was received by Appellant on 11/16/2004, which states:

> The sensors disclosed in Scherbatskoy ('680) still measure condition that indicate a change in downhole equipment conditions. For example, the sensors can sense an increase in downhole temperature near the bit could indicate increase in the temperature of the bit itself.
>
> [Emphasis added]

However, based on this statement, Appellant respectfully submits that Examiner has indicated that, in fact, the sensors of Scherbatskoy are designed and intended only to detect "downhole parameters in the earth's subsurface near the drill bit," [Col. 6, lines 16-17 of Scherbatskoy, emphasis added].

Hence the Examiner's argument is based on a modification of the teachings of Scherbatskoy which is neither taught nor suggested in Scherbatskoy. In fact, Scherbatskoy, by explicitly teaching that the sensors are designed and used to detect changes "near the drill bit," Scherbatskoy teaches away from the claimed limitation of signaling "a change in downhole equipment condition..." as recited in claim 14.

Appellant respectfully disagrees with Examiner Collins's contention that claim 14 is anticipated by Scherbatskoy because the foregoing sensors can indicate a change in downhole equipment conditions. Scherbatskoy never states that the sensors could indicate such a change in downhole equipment conditions.

Scherbatskoy is concerned with measuring parameters in the earth's subsurface while drilling. Scherbatskoy provides no means for converting the signals representing parameters of the earth's subsurface into signals representing a change in the condition of downhole equipment such as the drill bit.

Given that the cited reference does not explicitly teach or suggest the limitations of claim 14, Appellant has considered whether Scherbatskoy might inherently teach the claimed limitations. Appellant concludes that this is not the case, as discussed below.

Express anticipation occurs when the invention is expressly disclosed in the prior art, patent or publication. In some cases, however, when the claimed invention is not described *in haec verba*, the "doctrine of inherency" is relied on to establish anticipation. Under the principles of inherency, a claim is anticipated if a structure in the prior art necessarily functions in accordance with the limitations of a process or method claim. *In re King*, 801 F.2d 1324, 231 U.S.P.Q. 136 (Fed. Cir. 1986). The missing claimed characteristics must be a "natural result" flowing from what is disclosed. *Continental Can Co. v. Monsant Co.*, 948 F.2d 1264, 20 U.S.P.Q.2d 1746 (Fed. Cir. 1991). Unstated elements in a reference are inherent when they exist as a "matter of scientific fact". *Constant v. Advanced Micro-Devices, Inc.*, 848 F.2d 1560, 7

U.S.P.Q.2d 1057 (Fed. Cir.), *cert. denied*, 488 U.S. 892 (1988) and *Hughes Aircraft Co. v. United States*, 8 U.S.P.Q.2d 1580 (Ct. Cl. 1988). Otherwise, the invention is not inherently anticipated.

In the present case, the Scherbatskoy reference fails to expressly disclose the claimed limitation of signaling "a change in downhole equipment condition...." Further, the reference also fails to inherently teach this claimed limitation, because the taught structure of the reference does not necessarily function in accordance with the limitations of the proposed claim, as required for the doctrine of inherency to apply. Many of the sensors listed [see, e.g., col. 13, lines 6-15 of Scherbatskoy], including gamma ray sensors, pressure sensors, gas content sensors, magnetic compasses, etc. are applicable to measuring the condition of the earth's surface near the bit, but are not useful in indicating the condition of the downhole equipment. For example, the magnetic compass would provide no useful information about the condition of the drill bit or other downhole equipment. It is therefore respectfully submitted that Examiner has used the Appellant's application as a template to construct the innovations therein using the Scherbatskoy reference. The examiner may not use the claimed invention as an "instruction manual" or "template" to piece together the teachings of the prior art so that the invention is rendered obvious. *In re Fritch*, 972 F.2d 1260, 23 U.S.P.Q.2d

1780 (Fed. Cir. 1992). Such reliance is an impermissible use of hindsight with the benefit of applicant's disclosure. *Id.*

In view of the foregoing, Appellant respectfully submits that claim 14 is not anticipated by Scherbatskoy.

B. Claim 16 Is Not Anticipated by Scherbatskoy

Claim 16 depends directly from claim 1 and incorporates all the limitations thereof. Claim 16 also includes an additional limitation that "a reduction in drilling fluid long-time average pressure is caused by cycling a valve through a position which reduces fluid pressure and through a position which restores fluid flow to its normal state."

Scherbatskoy fails to teach the limitation in claim 16 of restoring fluid flow to its normal state. Appellant respectfully disagrees with Examiner Collins's contention that Scherbatskoy discloses the limitation of claim 16 in column 2, lines 4-20 and column 3, lines 60-64. In column 2, Scherbatskoy indicates that the prior art teaches the use of valves to either restrict mud flow or bypass some flow to a low pressure zone. Further, in column 3, Scherbatskoy only mentions slow pressure variation but does not suggest that such variation involves reducing the pressure and increasing it to its original state.

Accordingly, Appellant respectfully submits that claim 16 is not anticipated by Scherbatskoy.

C. Claim 17 Is Not Anticipated by Scherbatskoy

Claim 17 depends directly from claim 14 and incorporates all the limitations thereof. Accordingly, the same distinctions between Scherbatskoy and claim 14, which are described above, are applicable to claim 17. Appellant therefore respectfully submits that claim 17 is not anticipated by Scherbatskoy.

II. Whether claim 18 is obvious under 35 U.S.C. § 103 over Scherbatskoy in view of U.S. Patent No. 5,511,037 to Randall et al. (hereinafter "Randall").

To establish a *prima facie* case of obviousness, the prior art reference (or references when combined) must teach or suggest all the claim limitations (MPEP 2142). Claim 18 depends directly from claim 14 and incorporates all the limitations thereof. Claim 18 also includes an additional limitation that the "change in downhole equipment condition is determined by an adaptive filter which analyzes data from sensors located on the drill string."

Appellant respectfully disagrees with Examiner Collins's position that Scherbatskoy discloses the method of claim 14. **For**

the reasons described previously, Scherbatskoy neither teaches nor suggests using downhole circuitry to signal a change in downhole equipment condition. If Randall and Scherbatskoy could be properly combined, a combination thereof would result in an instrument directed at gathering information about the condition of the bore hole rather than the condition of downhole equipment.

In view of the foregoing, Appellant respectfully submits that the cited prior art references do not establish a *prima facie* case of obviousness as to claim 18.

III. Whether every element of claim 15 is shown in the Figures.

Examiner Collins has objected to claim 15 because he believes that new Figure 62 does not show how the valve 4710 is irreversible. According to 37 CFR § 1.83, "every feature of the invention specified in the claims" must be shown in the drawings of a nonprovisional application. However, 37 CFR § 1.83 also indicates that conventional features can be illustrated in the drawings in the form of a graphical drawing symbol or a labeled representation "where their detailed illustration is not essential for a proper understanding of the invention."

Claim 15 includes the limitation that "said reduction in drilling fluid long-time average pressure is caused by irreversible

movement of a valve." Appellants respectfully submit that Examiner Collins is incorrect in believing that the nature of how valve 4710 works irreversibly must be shown in the drawing. A person of ordinary skill in the art would know how an irreversible valve works and does not need a detailed illustration of such to properly understand the invention. Irreversible valves are conventional and thus can be shown in the form of a labeled representation.

Both Figures 61 and 62 include a labeled representation of irreversible valve 4710. A description of the irreversible or "one-shot" valve is contained in the specification on page 41, lines 11-18. Applicants therefore submit that the labeled representation of irreversible valve 4710 in Figures 61 and 62 meets the requirement of 37 CFR § 1.83.

Requested Relief

For the reasons advanced above, Appellant respectfully contends that claims 14-18 are patentable. Therefore, reversal of rejections and objections is respectfully requested.

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection of this paper, including extension of time

fees, to Deposit Account 07-2320 and please credit any excess fees to such deposit account.

Respectfully submitted,

Michelle L. Henderson

Michelle L. Henderson
Reg. No. 42,654
Attorney for Appellant

APPENDIX A – Text of Claims

1. A system for monitoring drill bit performance, comprising:
   a plurality of sensors located on a downhole section of the drill string; and
   circuitry for processing the states of said sensors to thereby derive a first warning state when the states of said sensors indicate that failure of the bit is beginning, and
   a second warning state when the states of said sensors indicate that final failure of the bit is at hand.

2. The system of Claim 1, wherein said first warning state is indicated to a surface operator by variation of drilling fluid pressure, said variation caused by movement of a valve located in said drill string.

3. The system of Claim 1, wherein said first and said second warning states are indicated to a surface operator by varying the position of a valve located in said drill string.

4. The system of Claim 1, wherein said first warning state and said second warning state are independently derived, and said second warning state can be detected by said sensors and said circuitry even under some failure conditions which would preclude detection of said first warning state.

5. The system of Claim 1, wherein said sensors include both a first type of sensor and a second type of sensor.

6. A downhole assembly which indicates a failure condition:
by irreversible movement of a valve which affects mud flow impedance
from a first state which is initially present during normal drilling
irreversibly into at least one intermediate state which indicates a failure condition, and thereafter irreversibly
into a final state, which returns mud flow impedance to substantially that seen during normal drilling.

7. The assembly of Claim 6, further comprising sensors located on said downhole assembly which monitor parameters indicative of drill bit condition.

8. The assembly of Claim 6, wherein said valve movement occurs at a time constant of at least about one second.

9. The assembly of Claim 6, wherein said mud flow impedance is varied by opening an aperture which allows mud to flow from the interior of the drill string to the bore hole.

10. A method of operating a drill rig, comprising the steps of: monitoring downhole mud flow impedance;

halting drilling when said impedance is altered by a downhole valve which opens or closes a shunt path for mud flow;

wherein said valve changes position according to readings of one or more sensors located on a downhole sub assembly.11. The method of Claim 10, wherein said one or more sensors measure axial strain.

11. The method of Claim 10, wherein said one or more sensors measure axial strain.

12. The method of Claim 10, wherein said one or more sensors measure vibrational frequency.

13. The method of Claim 10, wherein data from said one or more sensors are analyzed by an adaptive filter.

14. A method of operating a drill rig, comprising the step of: signalling a change in downhole equipment condition by causing a variation in drilling fluid static pressure.

15. The method of Claim 14, wherein said pressure variation is caused by irreversible movement of a valve.

16. The method of Claim 14, wherein said pressure variation is caused by cycling a valve through a position which restricts fluid flow and through a position which restores fluid flow to its normal state.

17. The method of Claim 14, wherein said change in downhole . equipment condition is detected by a downhole sensor.

18. The method of Claim 14, wherein said change in downhole equipment condition is determined by an adaptive filter which analyzes data from sensors located on the drill string.

APPENDIX B – Copy of Application Drawings

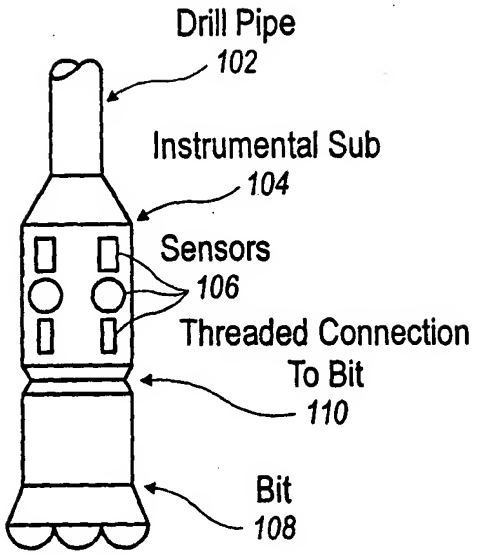

FIG. 1

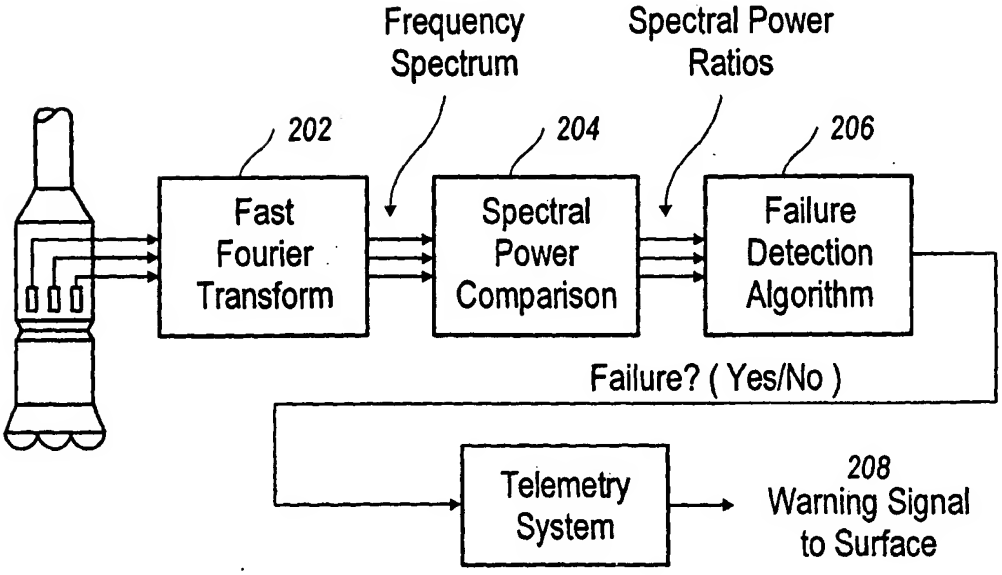

FIG. 2

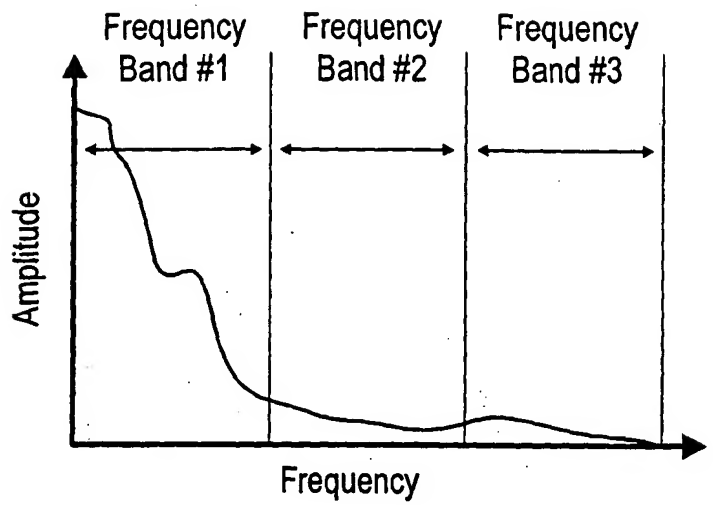
Frequency Band #1
Frequency Band #2
Frequency Band #3
Amplitude
Frequency

Fig. 3

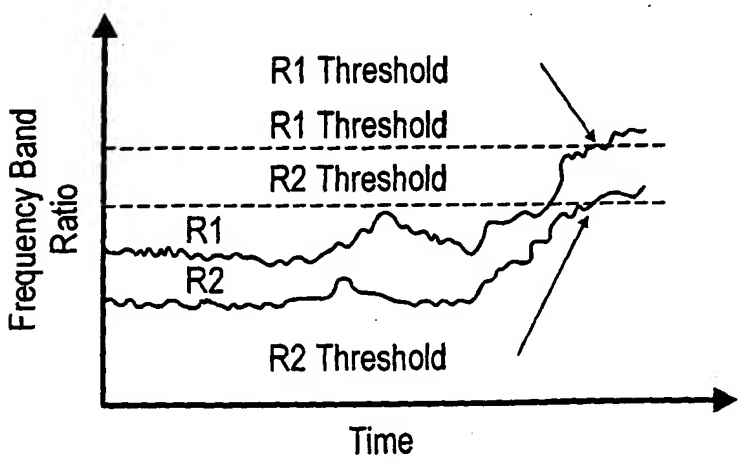
R1 Threshold
R1 Threshold
R2 Threshold
R1
R2
R2 Threshold
Frequency Band Ratio
Time

Fig. 4

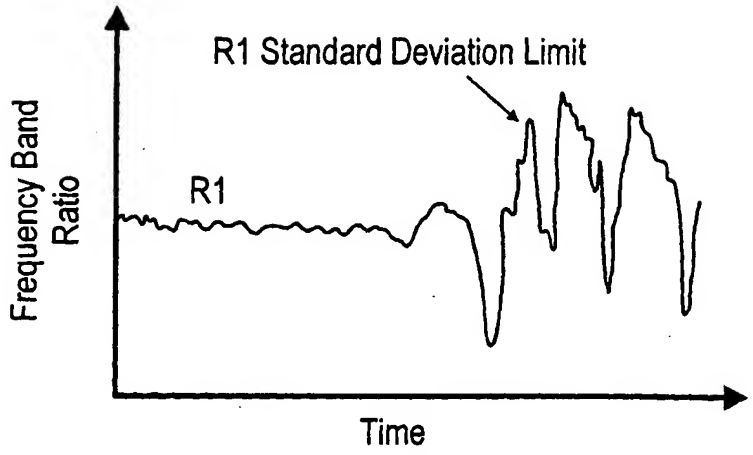
R1 Standard Deviation Limit
Frequency Band Ratio
R1
Time

Fig. 5

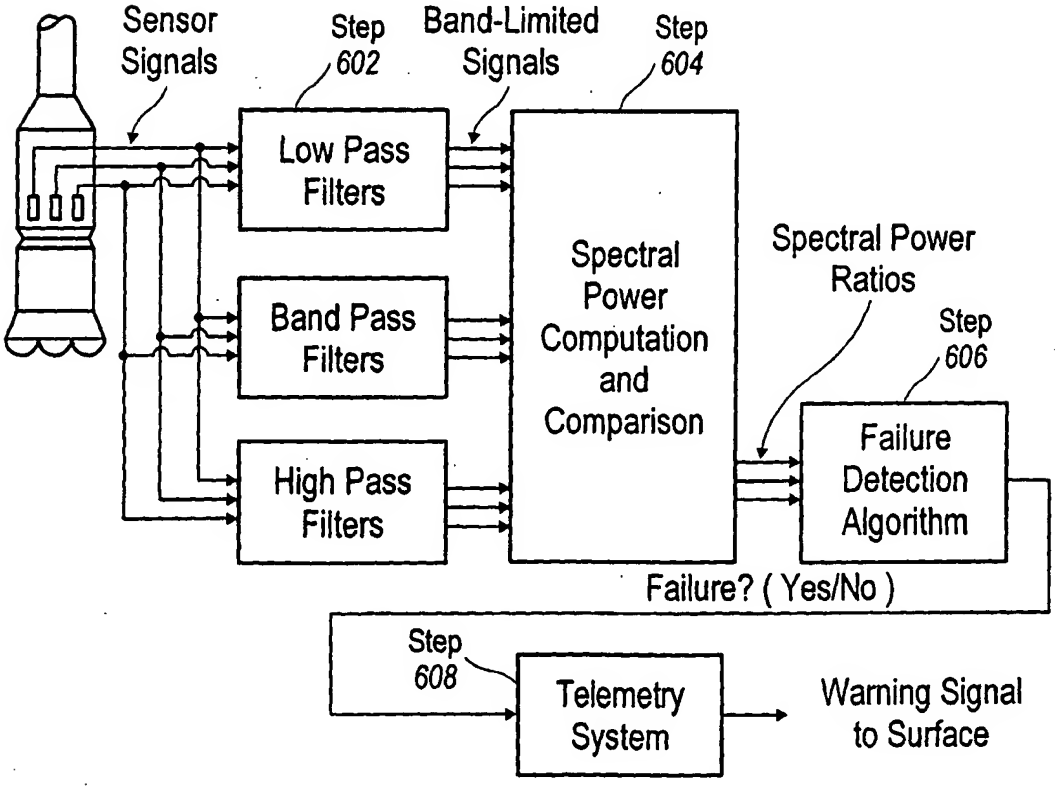
Sensor Signals
Step 602
Band-Limited Signals
Step 604
Low Pass Filters
Band Pass Filters
High Pass Filters
Spectral Power Computation and Comparison
Spectral Power Ratios
Step 606
Failure Detection Algorithm
Failure? (Yes/No)
Step 608
Telemetry System
Warning Signal to Surface

Fig. 6

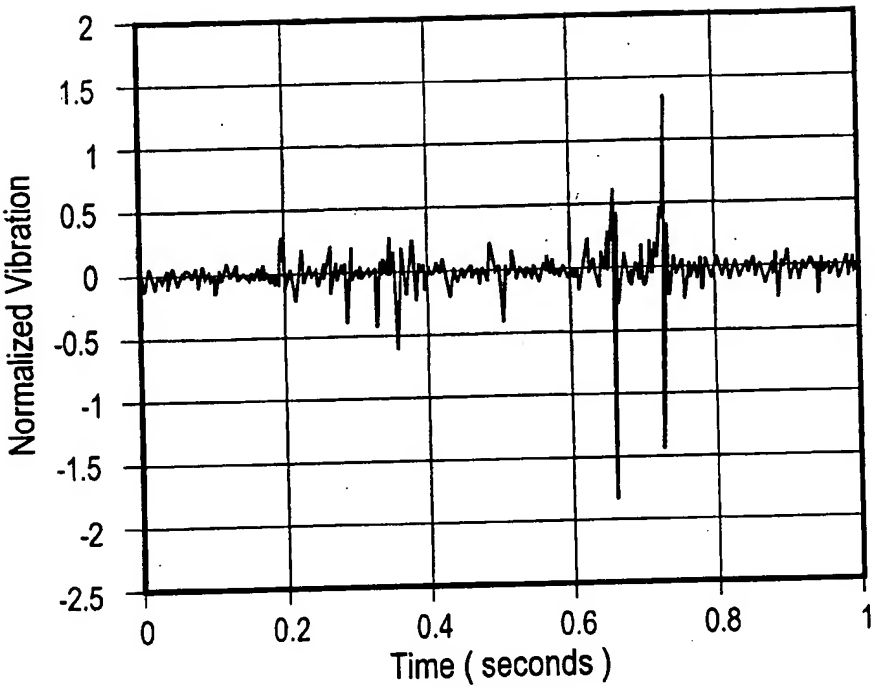
Normalized Vibration
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5
0
0.2
0.4
0.6
0.8
1
Time (seconds)

FIG. 7

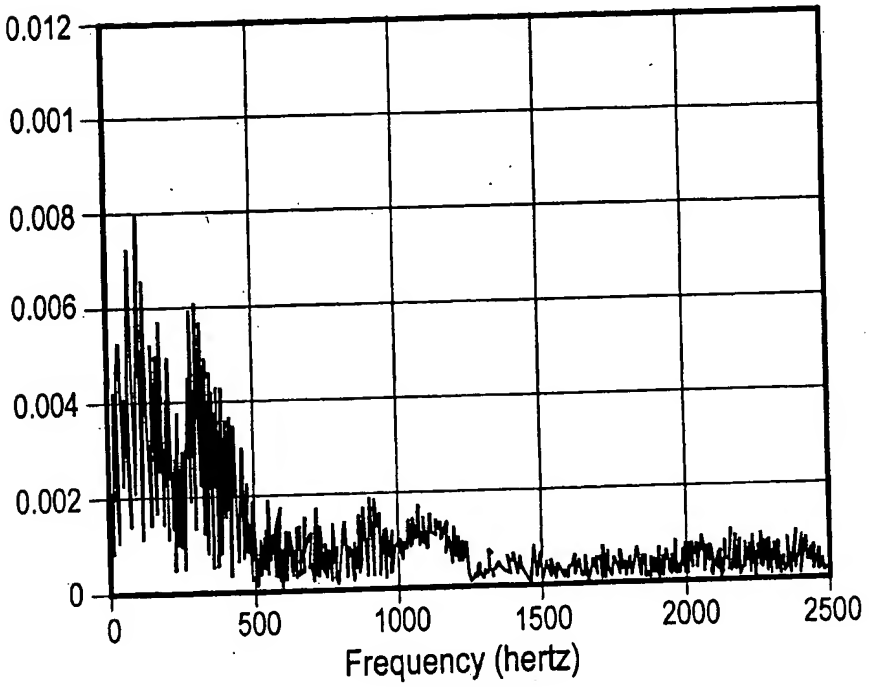
0.012
0.001
0.008
0.006
0.004
0.002
0
0
500
1000
1500
2000
2500
Frequency (hertz)

FIG. 8

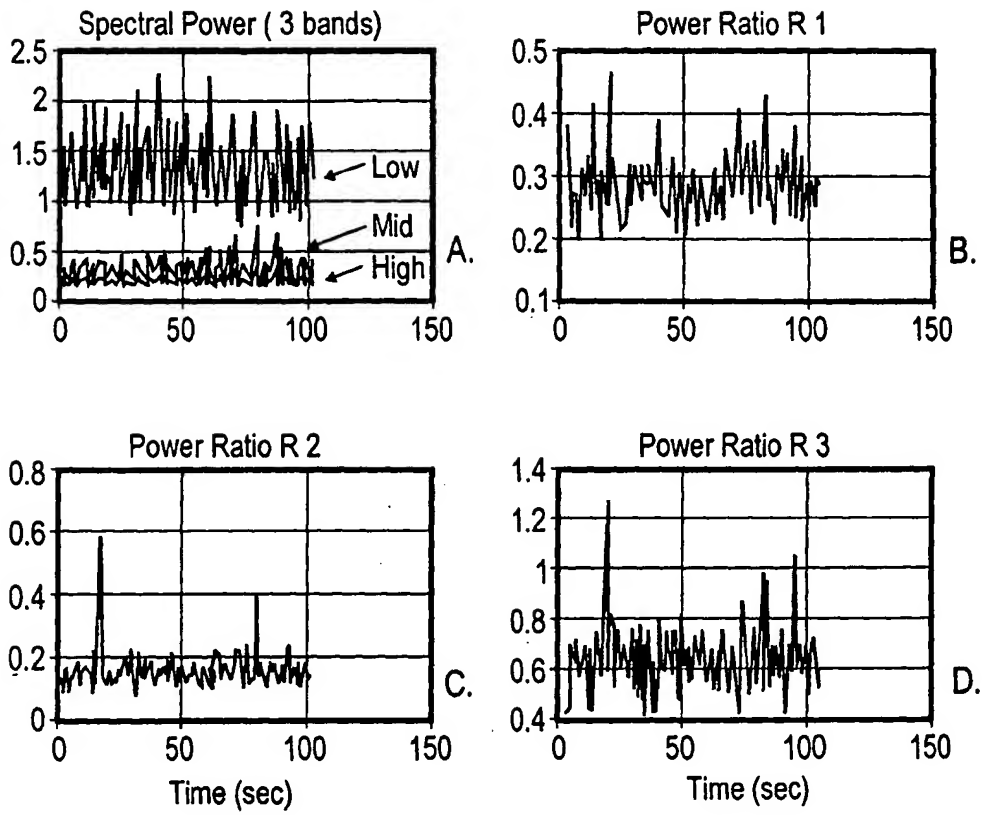
Spectral Power (3 bands)
2.5
2
1.5
1
0.5
0
Low
Mid
High
A.
0
50
100
150
Power Ratio R 1
0.5
0.4
0.3
0.2
0.1
B.
Power Ratio R 2
0.8
0.6
0.4
0.2
C.
Time (sec)
Power Ratio R 3
1.4
1.2
1
0.8
0.6
0.4
D.
Time (sec)

FIG. 9

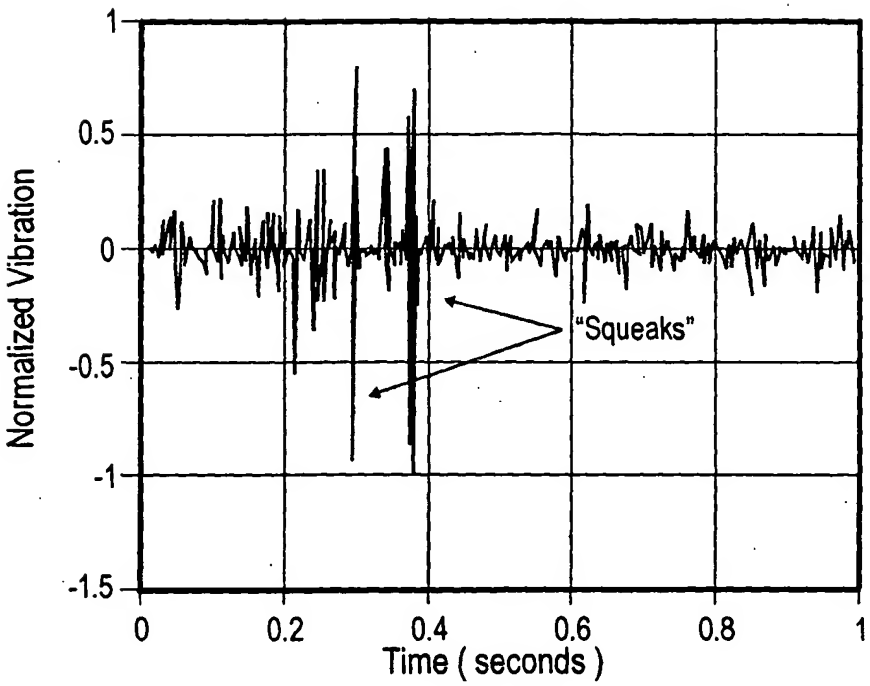
Normalized Vibration
1
0.5
0
-0.5
-1
-1.5
"Squeaks"
0
0.2
0.4
0.6
0.8
1
Time (seconds)

FIG. 10

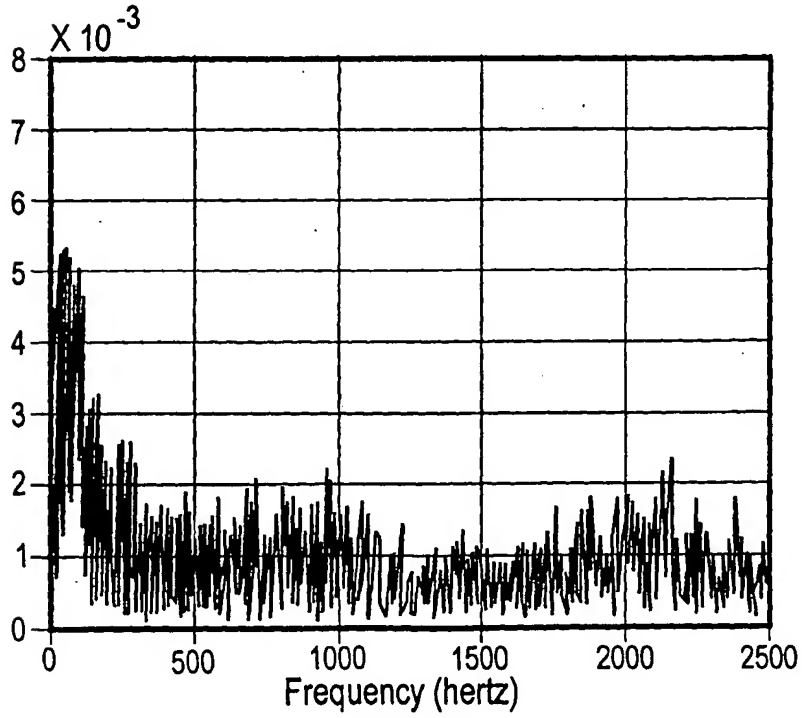
X 10 -3
8
7
6
5
4
3
2
1
0
0
500
1000
1500
2000
2500
Frequency (hertz)

FIG. 11

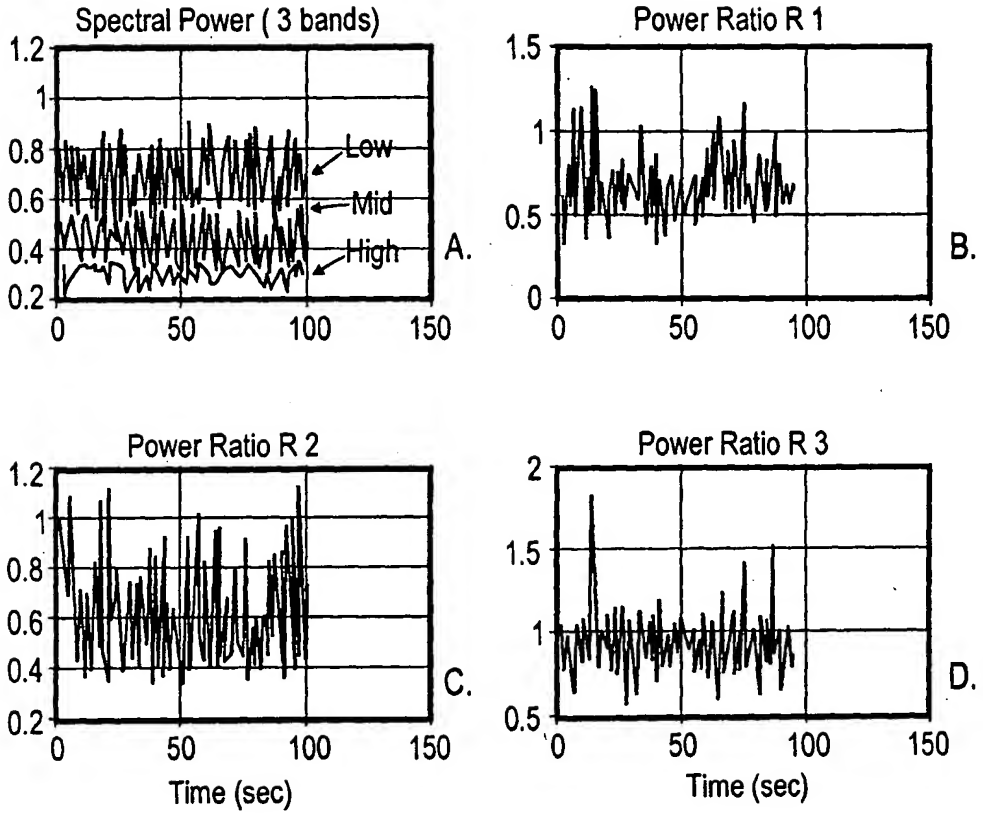
Spectral Power (3 bands)
1.2
1
0.8
0.6
0.4
0.2
0
50
100
150
Low
Mid
High
A.
Power Ratio R 1
1.5
1
0.5
0
B.
Power Ratio R 2
C.
Power Ratio R 3
2
1.5
D.
Time (sec)

Fig.1 2

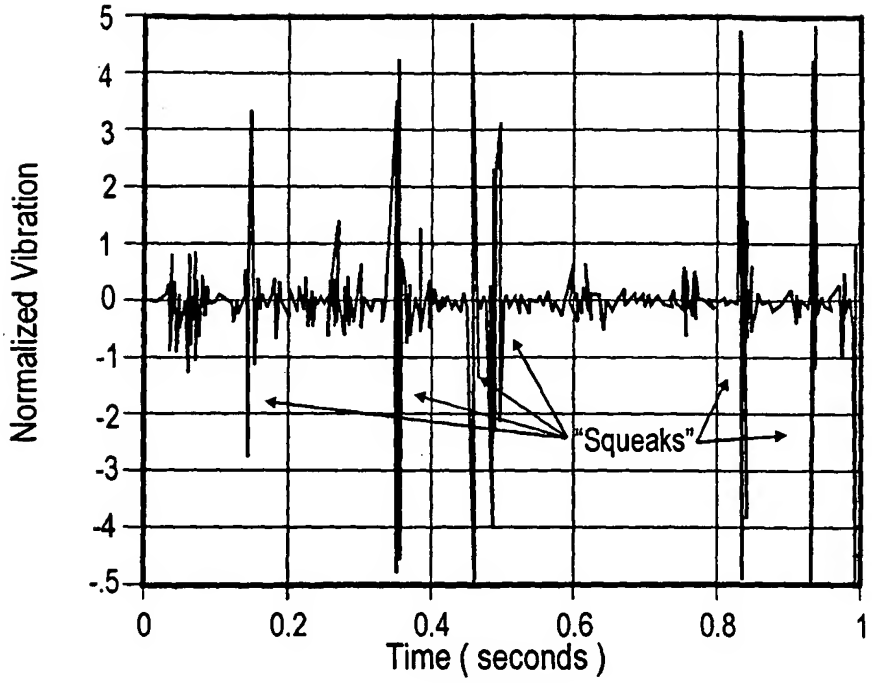
Normalized Vibration
5
4
3
2
1
0
-1
-2
-3
-4
-.5
0
0.2
0.4
0.6
0.8
1
Time (seconds)
"Squeaks"

FIG. 13

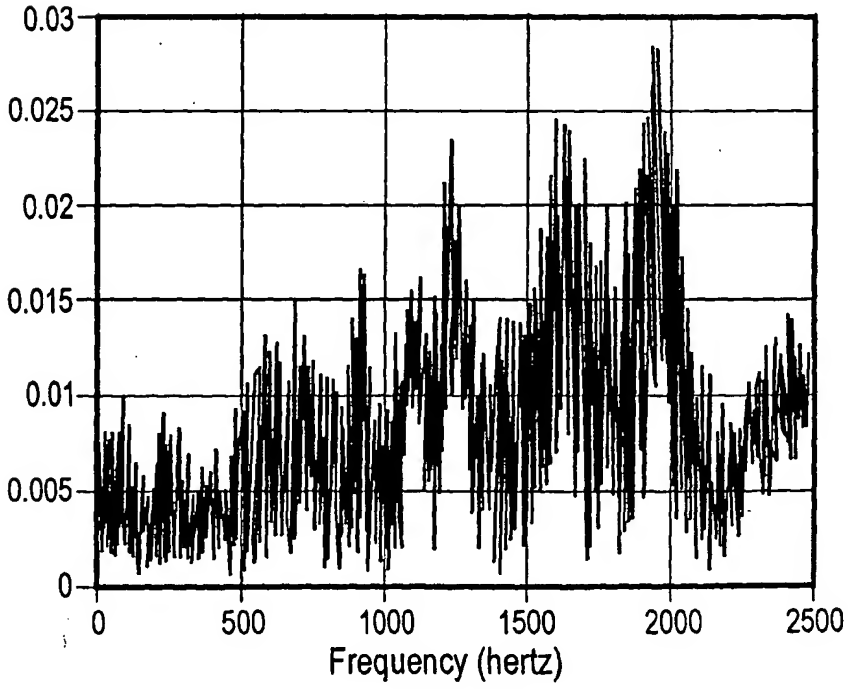
0.03
0.025
0.02
0.015
0.01
0.005
0
0
500
1000
1500
2000
2500
Frequency (hertz)

FIG. 14

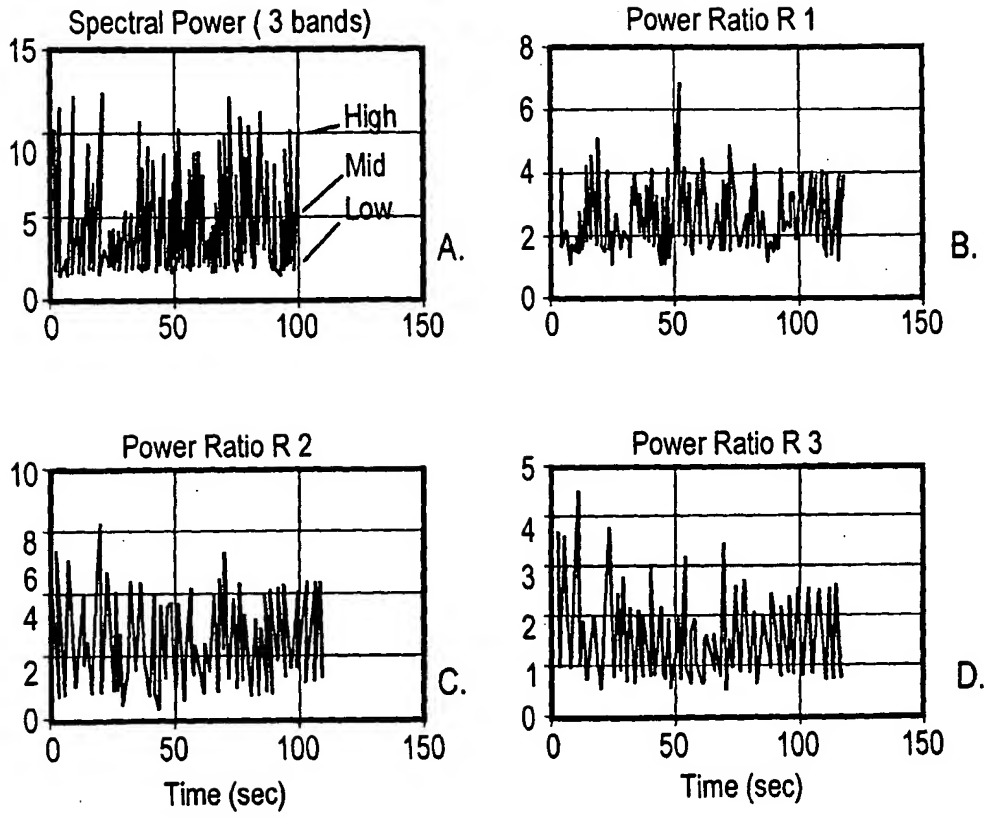
Spectral Power (3 bands)
High
Mid
Low
A.
Power Ratio R 1
B.
Power Ratio R 2
C.
Power Ratio R 3
D.
Time (sec)
Time (sec)

FIG. 15

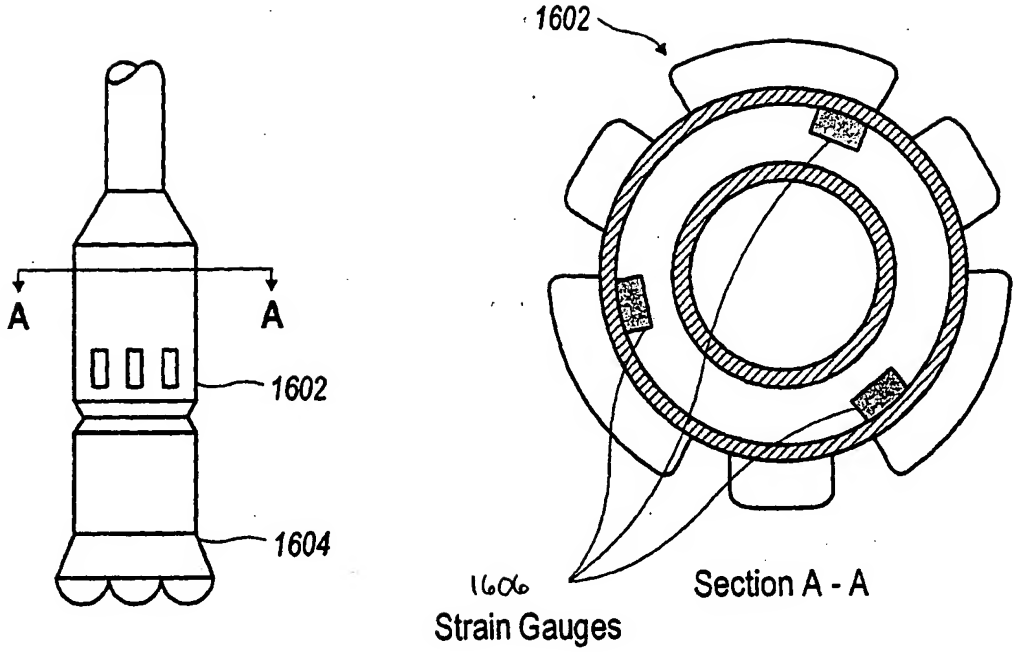
A
A
1602
1604
1602
1606
Strain Gauges
Section A - A

Fig.1 6

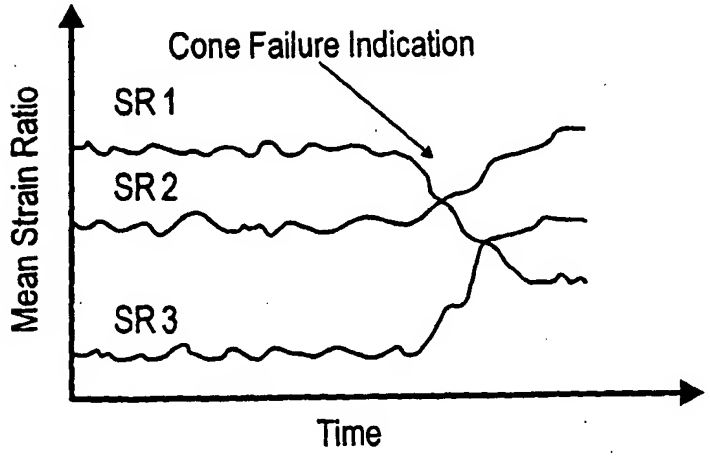
Cone Failure Indication
SR 1
SR 2
SR 3
Mean Strain Ratio
Time

Fig.1 7

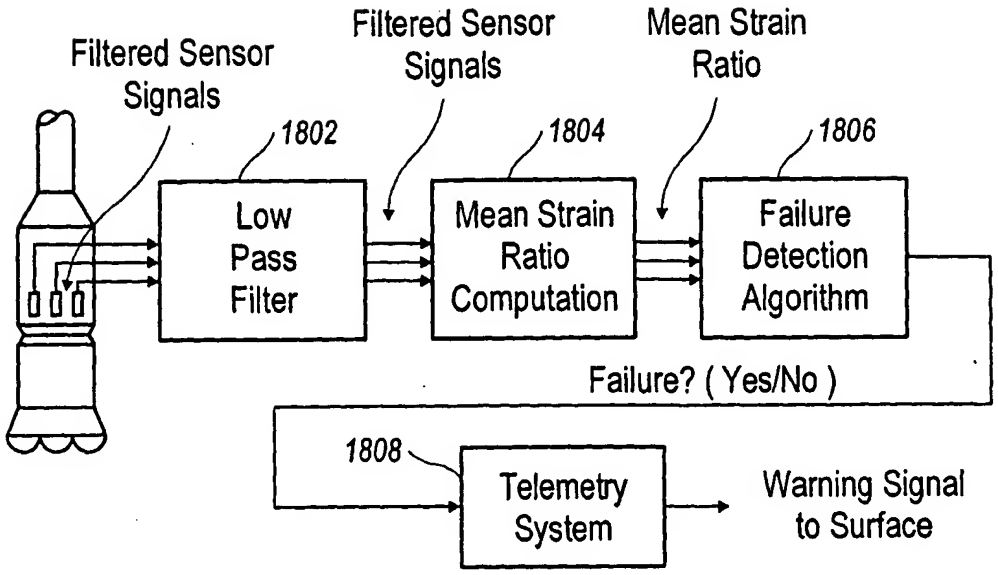
Filtered Sensor Signals
Filtered Sensor Signals
Mean Strain Ratio
1802
1804
1806
Low Pass Filter
Mean Strain Ratio Computation
Failure Detection Algorithm
Failure? (Yes/No)
1808
Telemetry System
Warning Signal to Surface

FIG.1 8

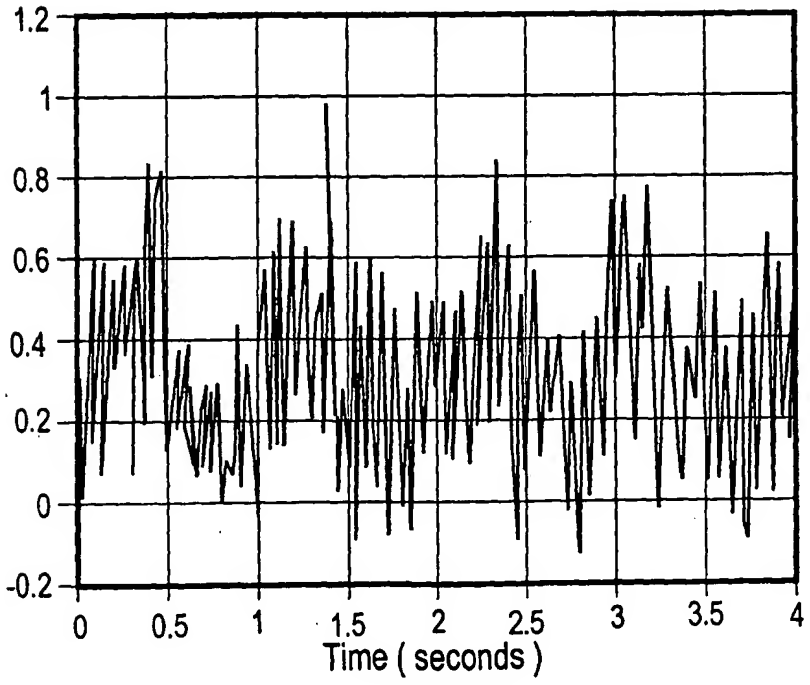
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
0
0.5
1
1.5
2
2.5
3
3.5
4
Time (seconds)

FIG.1 9

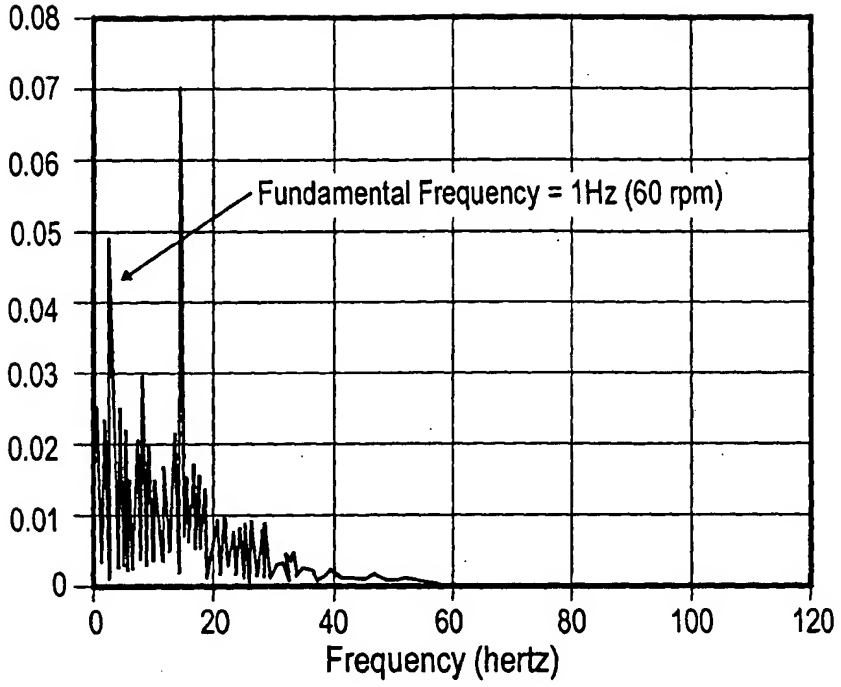
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Fundamental Frequency = 1Hz (60 rpm)
0
20
40
60
80
100
120
Frequency (hertz)

FIG. 20

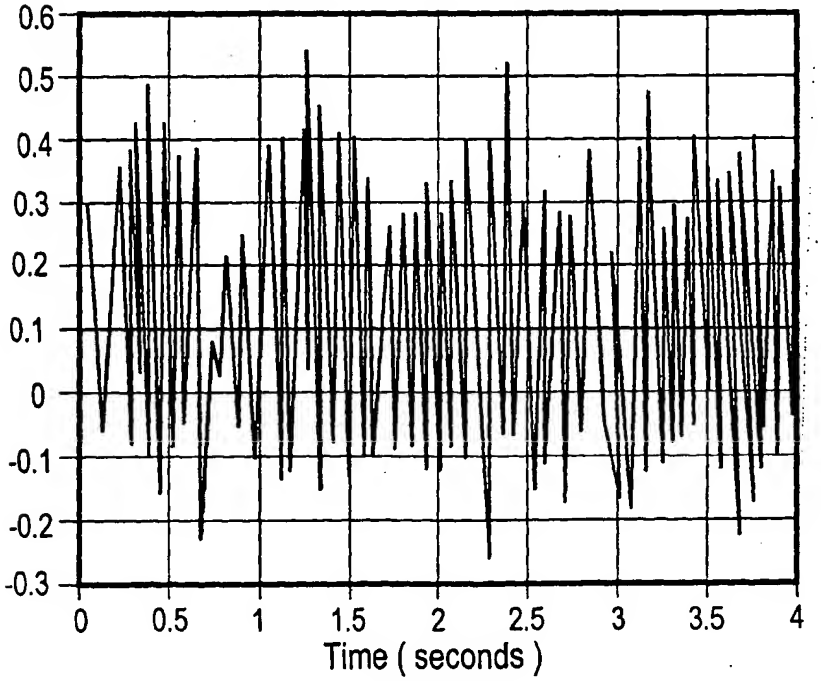
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
0
0.5
1
1.5
2
2.5
3
3.5
4
Time (seconds)

FIG. 22

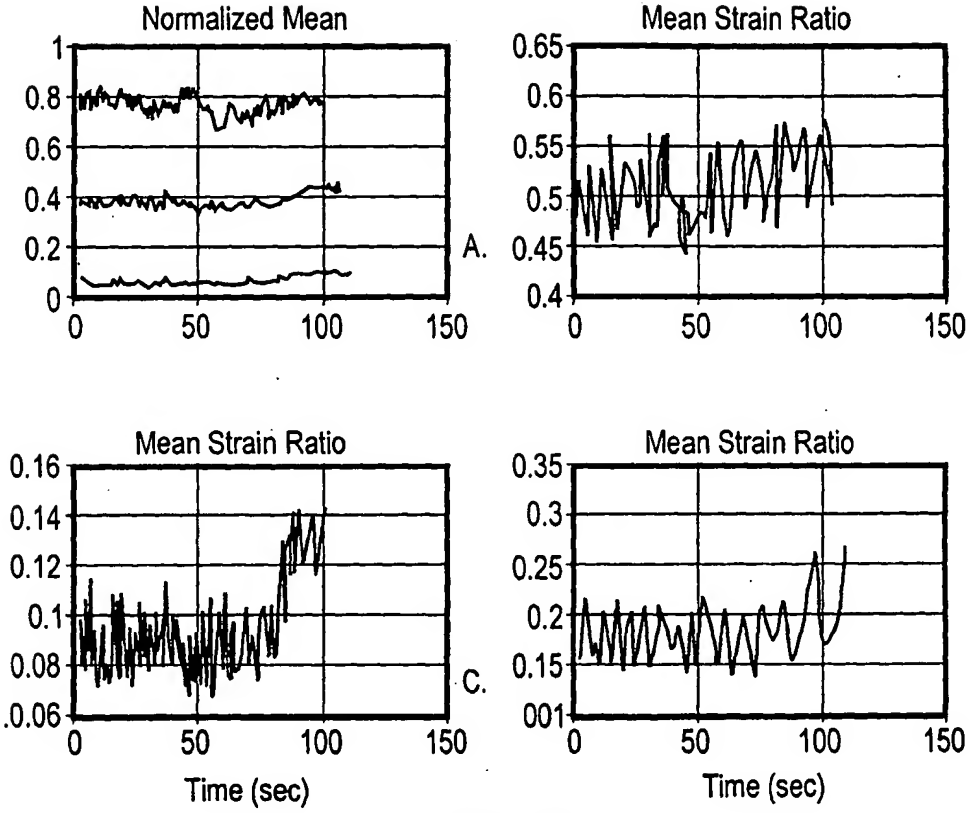
Normalized Mean
1
0.8
0.6
0.4
0.2
0
0
50
100
150
A.
Mean Strain Ratio
0.65
0.6
0.55
0.5
0.45
0.4
0
50
100
150
Mean Strain Ratio
0.16
0.14
0.12
0.1
0.08
.0.06
0
50
100
150
Time (sec)
C.
Mean Strain Ratio
0.35
0.3
0.25
0.2
0.15
001
0
50
100
150
Time (sec)

FIG. 21

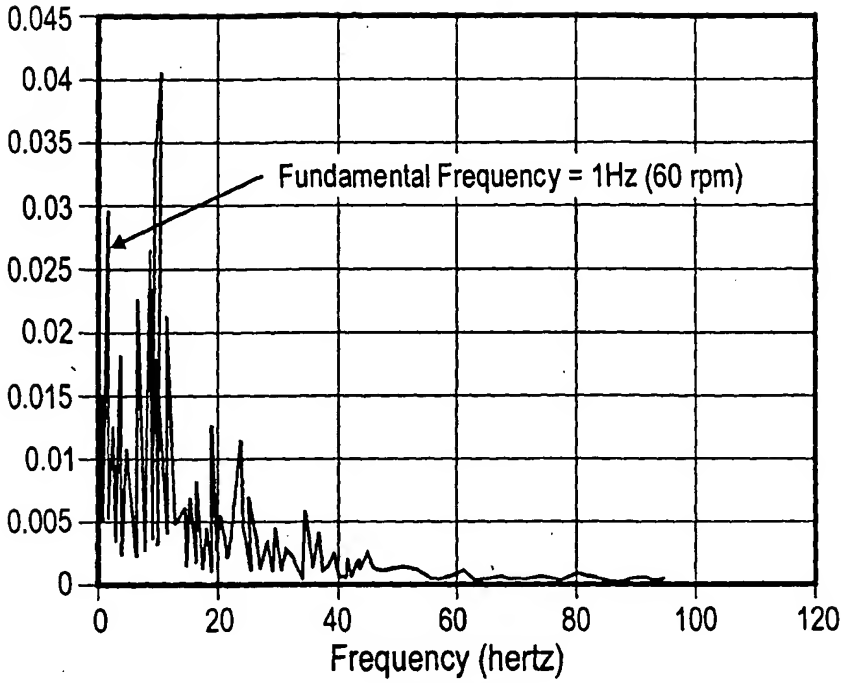
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
Fundamental Frequency = 1Hz (60 rpm)
0
20
40
60
80
100
120
Frequency (hertz)

FIG. 23

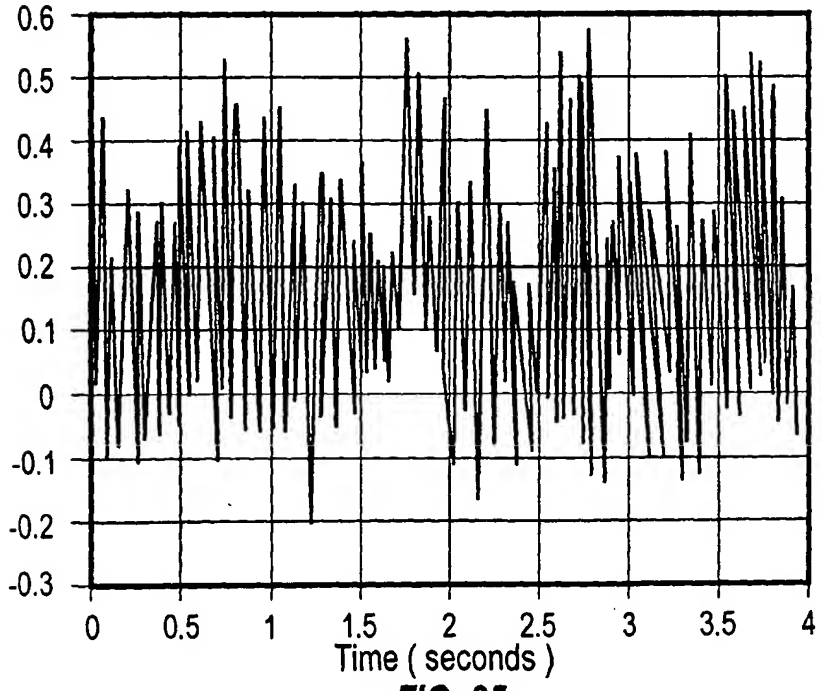
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
0
0.5
1
1.5
2
2.5
3
3.5
4
Time (seconds)

FIG. 25

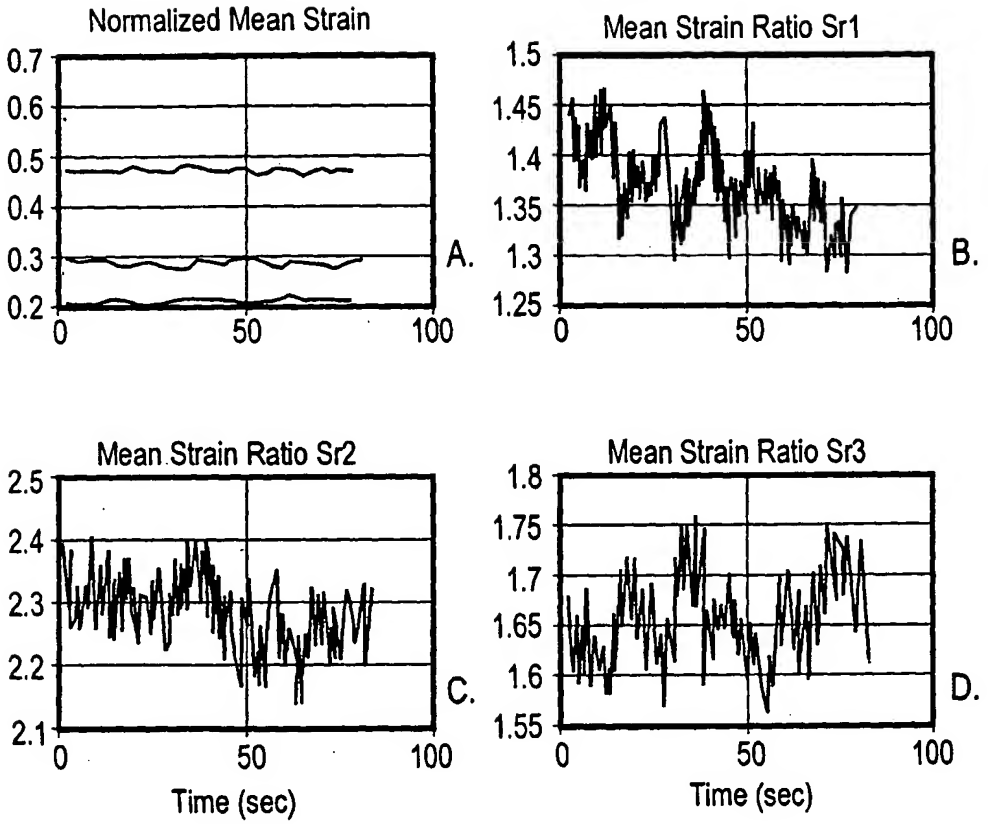
Normalized Mean Strain
0.7
0.6
0.5
0.4
0.3
0.2
0
50
100
A.
Mean Strain Ratio Sr1
1.5
1.45
1.4
1.35
1.3
1.25
0
50
100
B.
Mean Strain Ratio Sr2
2.5
2.4
2.3
2.2
2.1
0
50
100
Time (sec)
C.
Mean Strain Ratio Sr3
1.8
1.75
1.7
1.65
1.6
1.55
0
50
100
Time (sec)
D.

FIG. 24

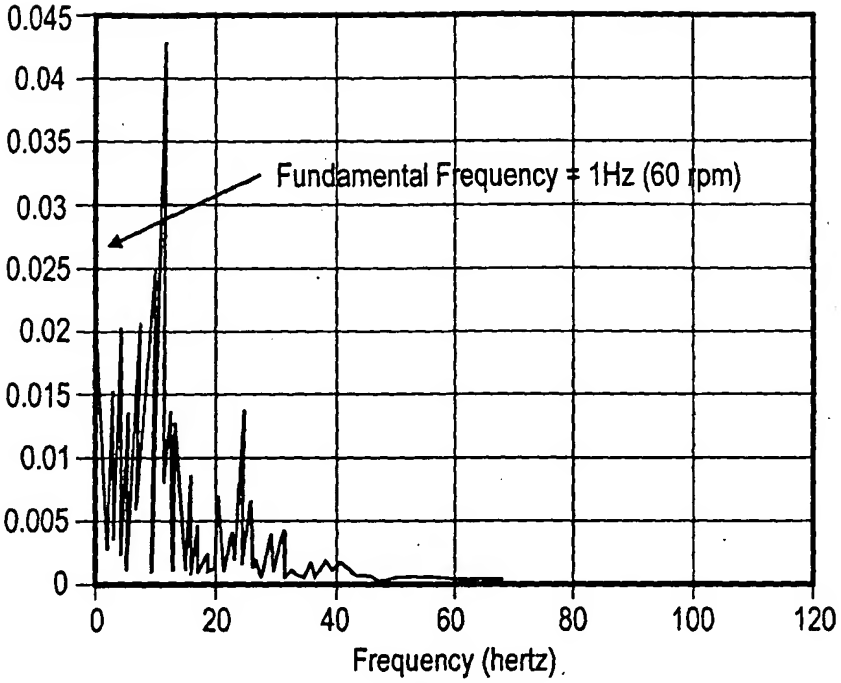
0.045
0.04
0.035
0.03
0.025
0.02
0.015
0.01
0.005
0
Fundamental Frequency = 1Hz (60 rpm)
0
20
40
60
80
100
120
Frequency (hertz)

FIG. 26

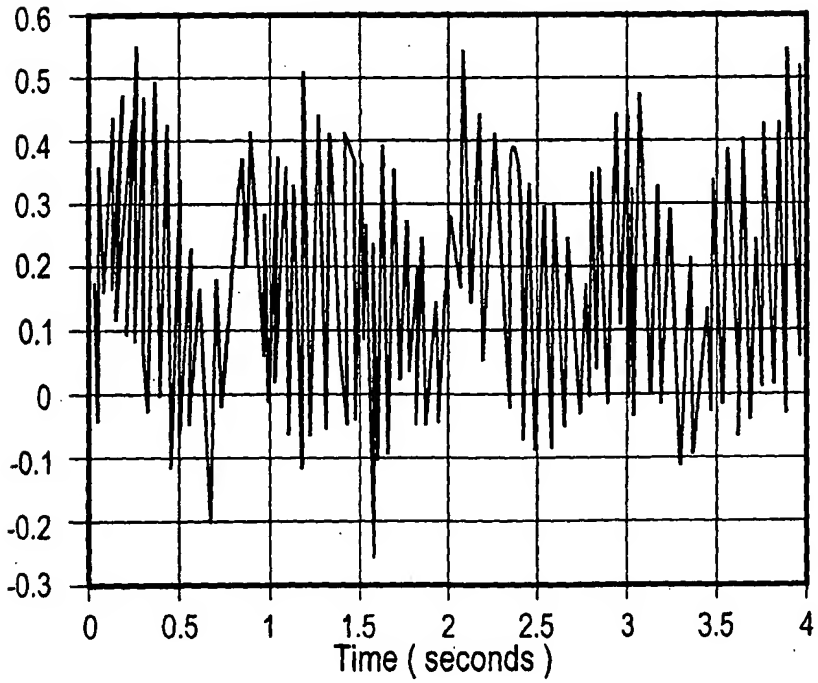
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
0
0.5
1
1.5
2
2.5
3
3.5
4
Time (seconds)

FIG. 28

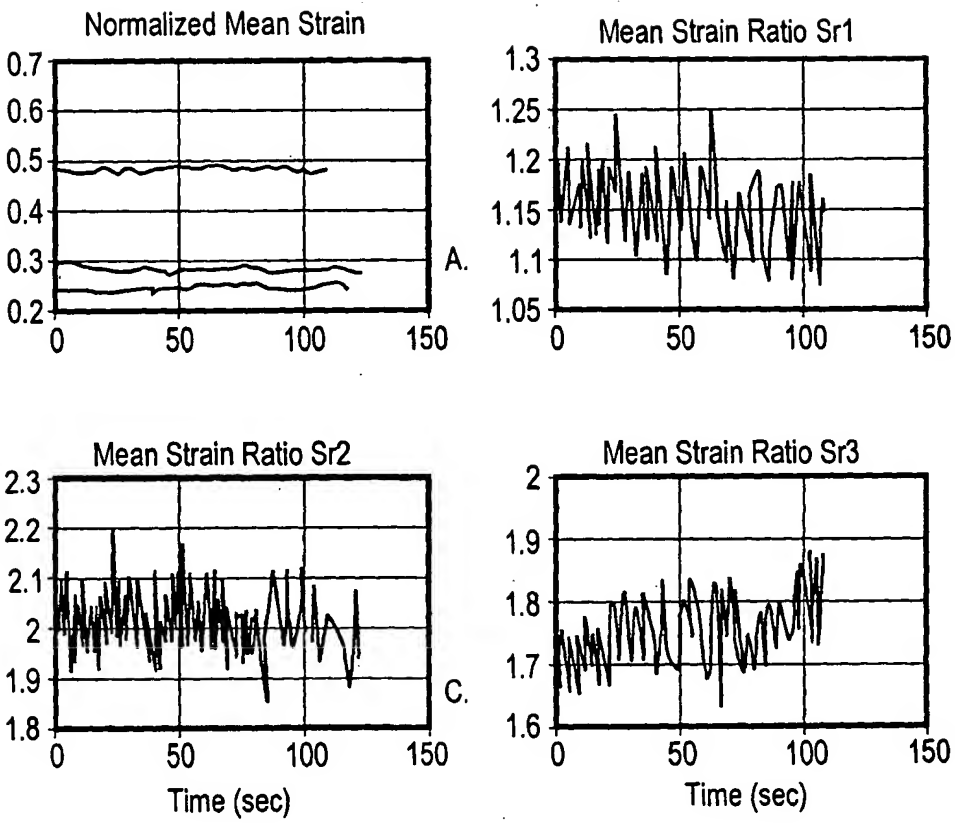
Normalized Mean Strain
0.7
0.6
0.5
0.4
0.3
0.2
0
50
100
150
A.
Mean Strain Ratio Sr1
1.3
1.25
1.2
1.15
1.1
1.05
0
50
100
150
Mean Strain Ratio Sr2
2.3
2.2
2.1
2
1.9
1.8
0
50
100
150
Time (sec)
C.
Mean Strain Ratio Sr3
2
1.9
1.8
1.7
1.6
0
50
100
150
Time (sec)

FIG. 27

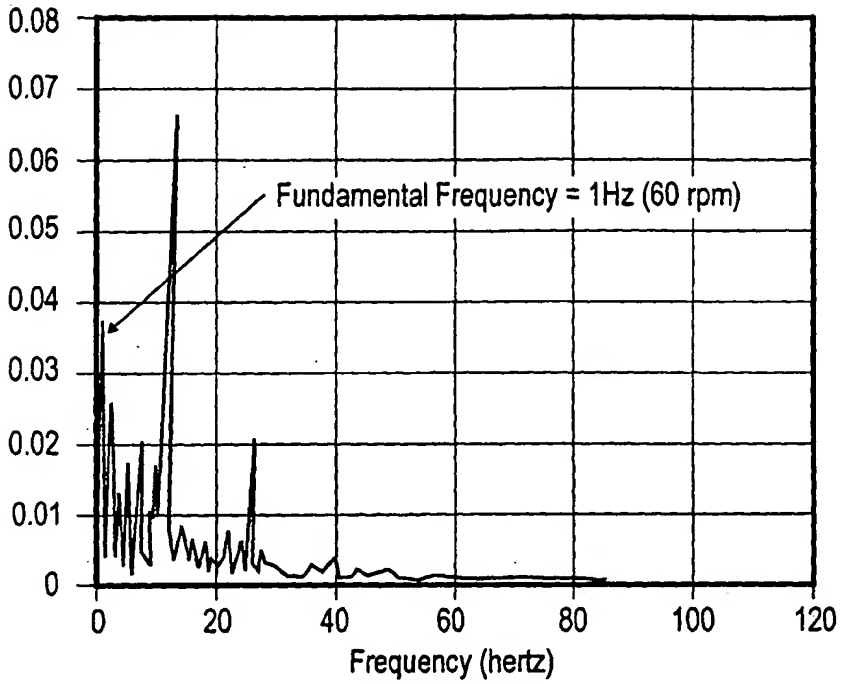
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Fundamental Frequency = 1Hz (60 rpm)
0
20
40
60
80
100
120
Frequency (hertz)

FIG. 29

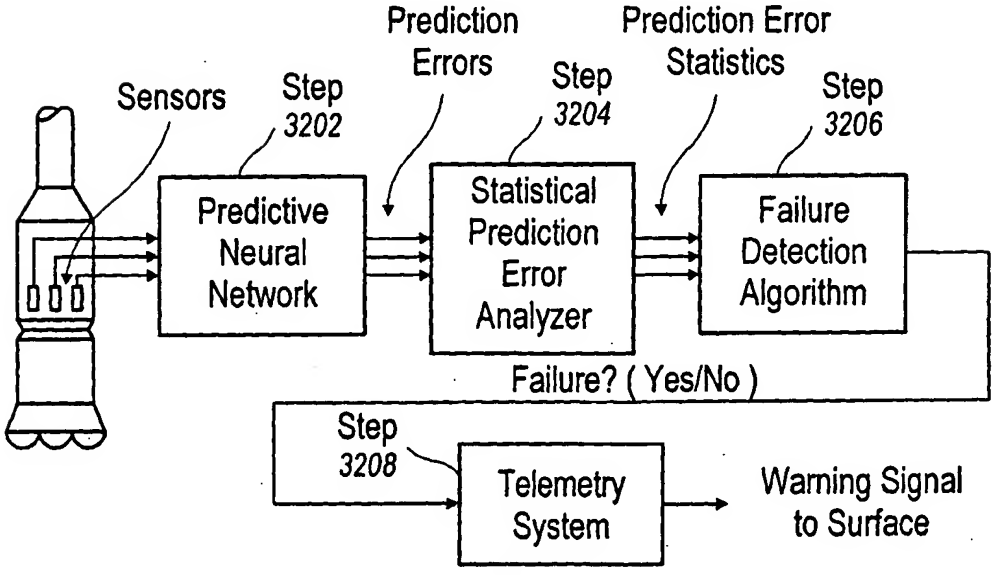
Sensors
Step 3202
Predictive Neural Network
Prediction Errors
Step 3204
Statistical Prediction Error Analyzer
Prediction Error Statistics
Step 3206
Failure Detection Algorithm
Failure? (Yes/No)
Step 3208
Telemetry System
Warning Signal to Surface

FIG. 32

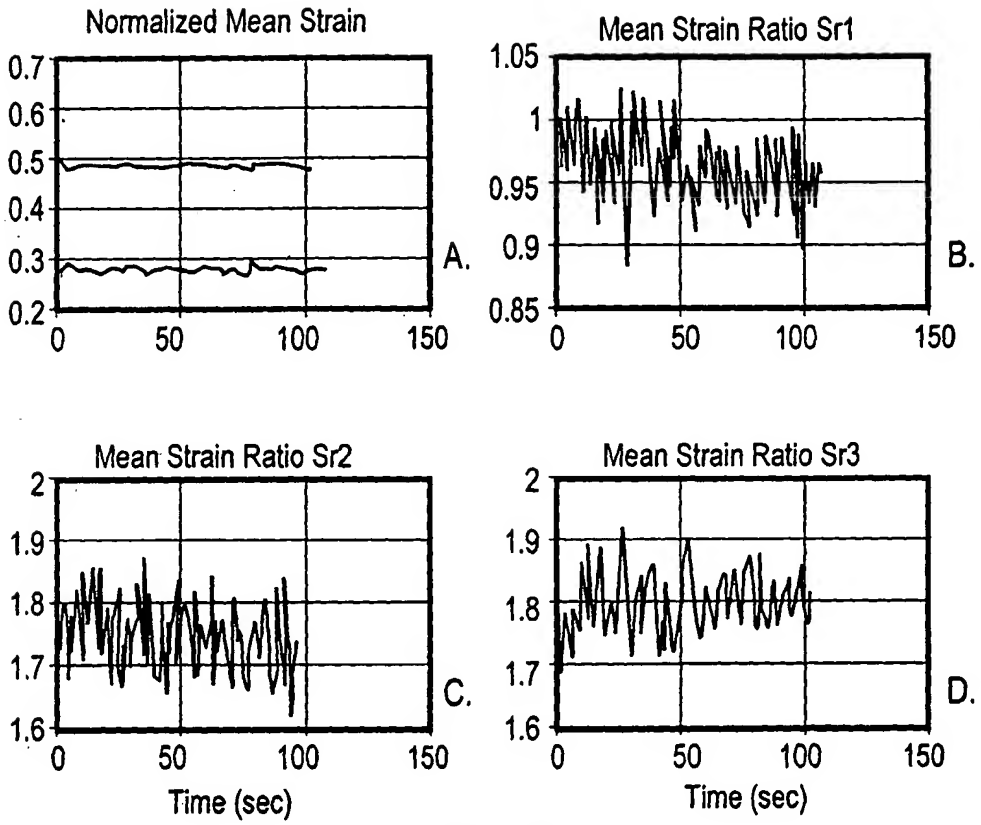
Normalized Mean Strain
0.7
0.6
0.5
0.4
0.3
0.2
0
50
100
150
A.
Mean Strain Ratio Sr1
1.05
1
0.95
0.9
0.85
0
50
100
150
B.
Mean Strain Ratio Sr2
2
1.9
1.8
1.7
1.6
0
50
100
150
Time (sec)
C.
Mean Strain Ratio Sr3
2
1.9
1.8
1.7
1.6
0
50
100
150
Time (sec)
D.

FIG. 30

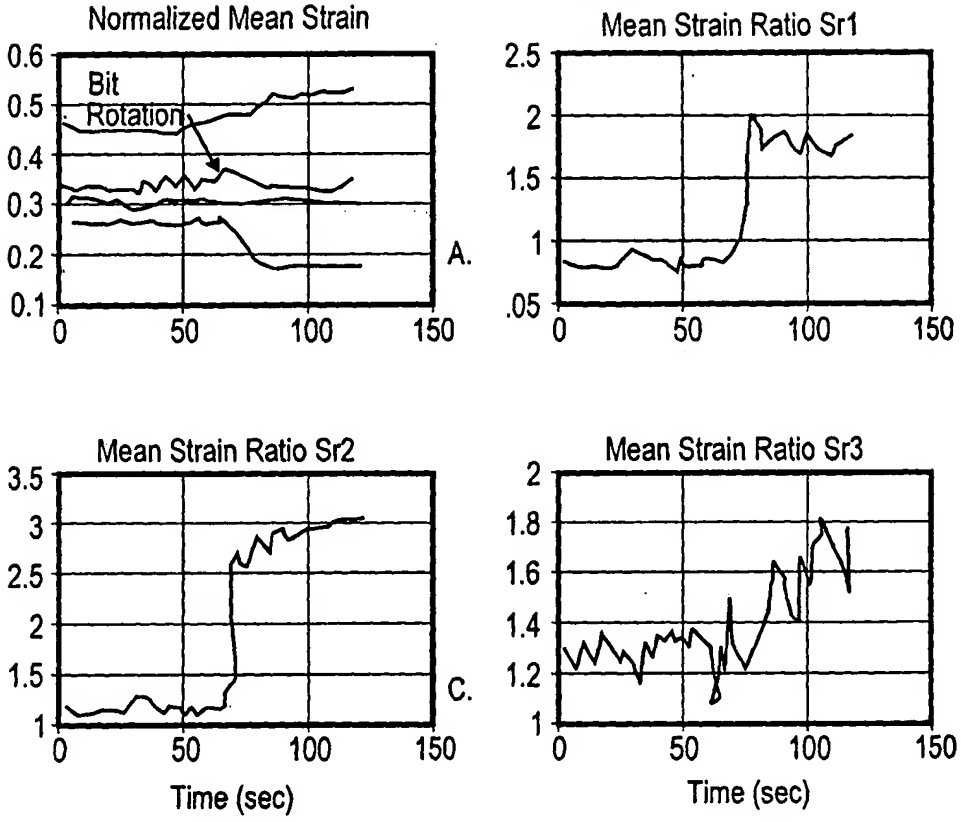
Normalized Mean Strain
Bit Rotation
0.6
0.5
0.4
0.3
0.2
0.1
0
50
100
150
A.
Mean Strain Ratio Sr1
2.5
2
1.5
1
.05
0
50
100
150
Mean Strain Ratio Sr2
3.5
3
2.5
2
1.5
1
0
50
100
150
C.
Time (sec)
Mean Strain Ratio Sr3
2
1.8
1.6
1.4
1.2
1
0
50
100
150
Time (sec)

FIG. 31

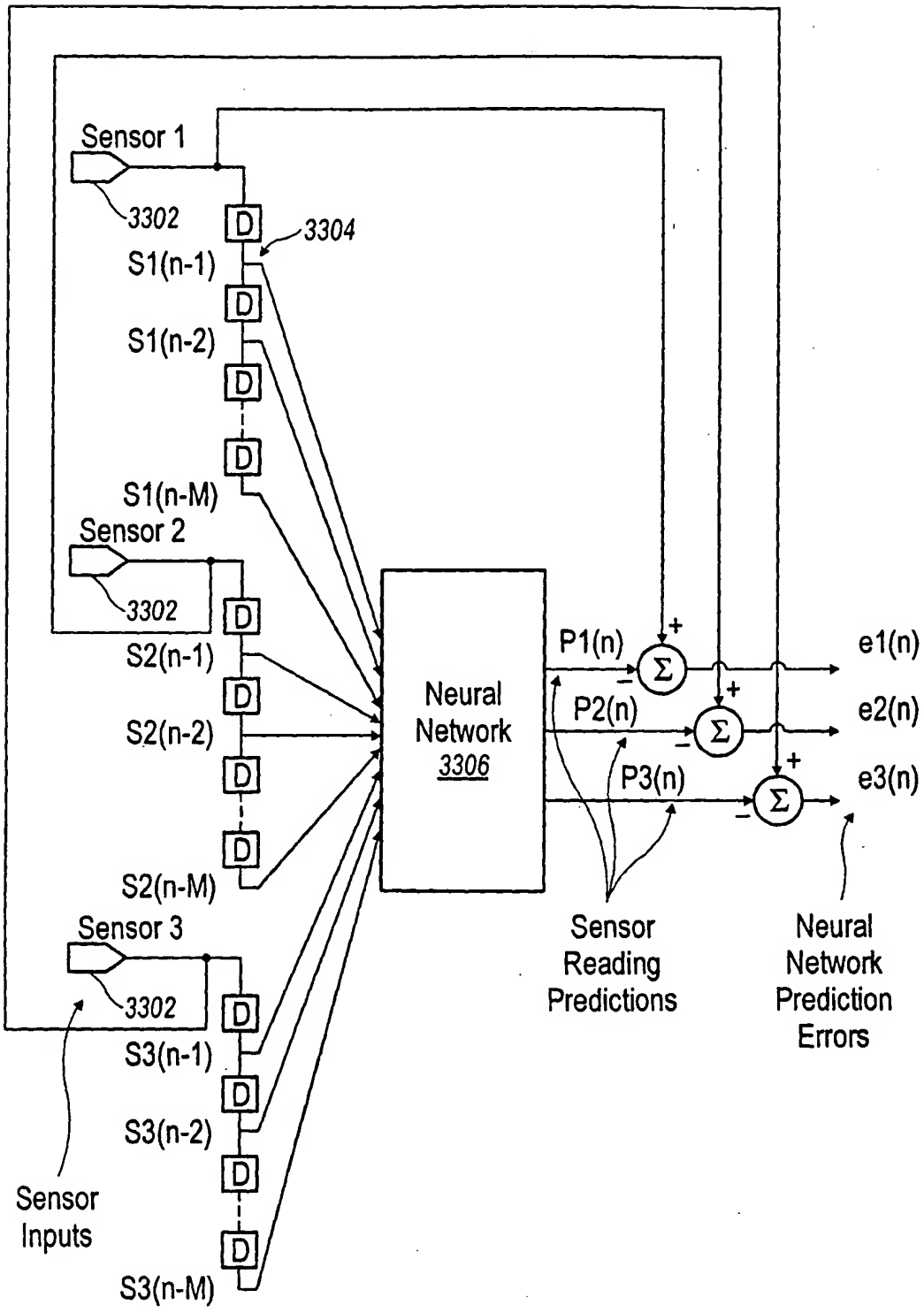
Sensor 1
3302
3304
S1(n-1)
S1(n-2)
S1(n-M)
Sensor 2
3302
S2(n-1)
S2(n-2)
S2(n-M)
Sensor 3
3302
S3(n-1)
S3(n-2)
S3(n-M)
Sensor Inputs
D
Neural Network 3306
P1(n)
P2(n)
P3(n)
Σ
+
−
e1(n)
e2(n)
e3(n)
Sensor Reading Predictions
Neural Network Prediction Errors

Fig. 33

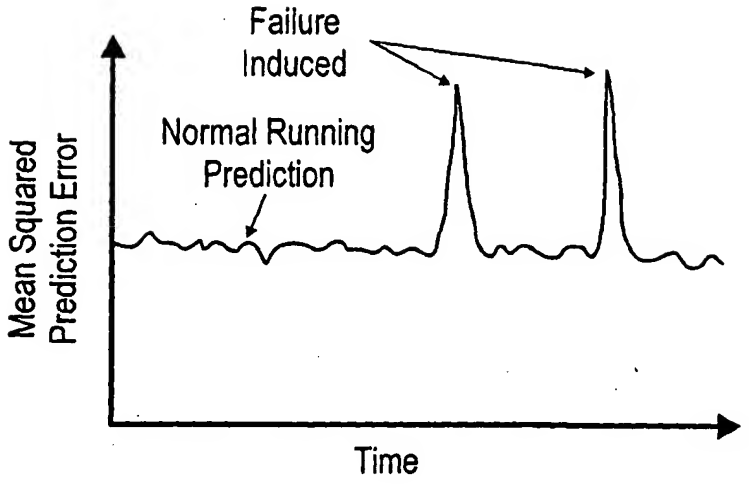
Failure
Induced
Normal Running
Prediction
Mean Squared
Prediction Error
Time

Fig. 34

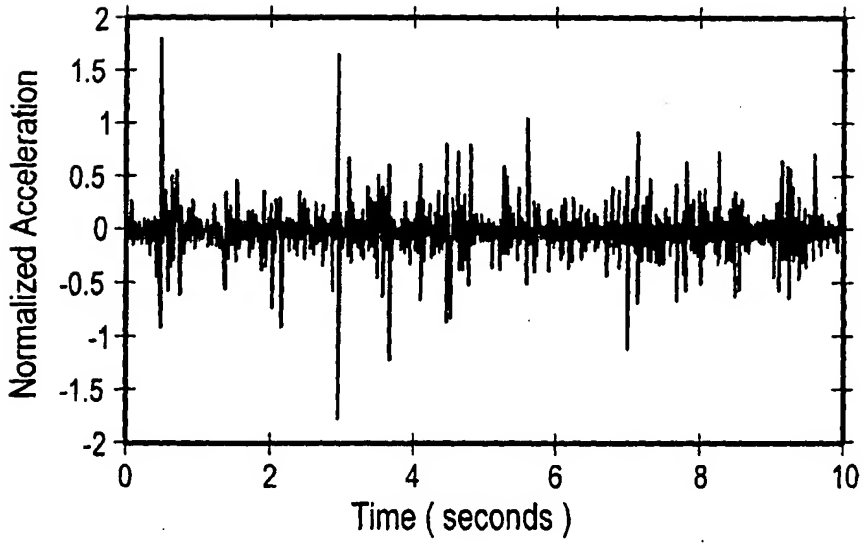
Normalized Acceleration
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
0
2
4
6
8
10
Time (seconds)

Fig.3 5

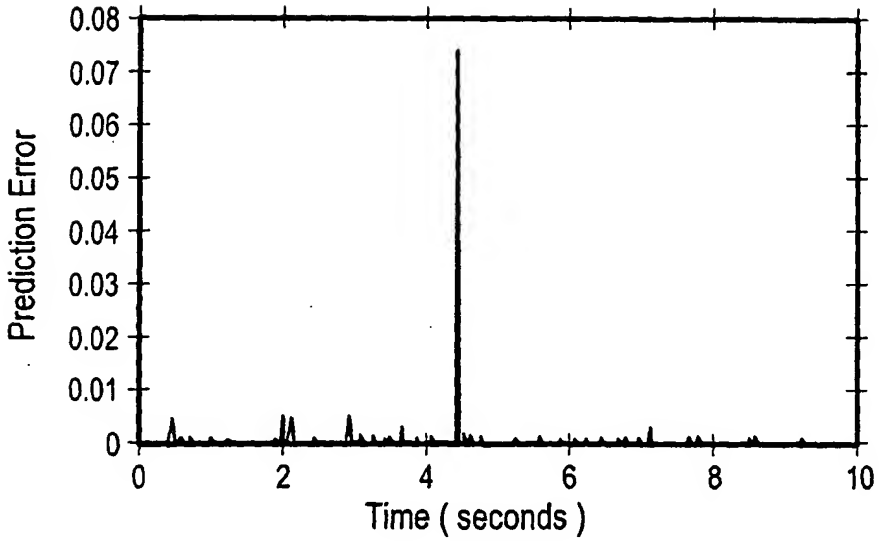
Prediction Error
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
0
2
4
6
8
10
Time (seconds)

Fig.3 6

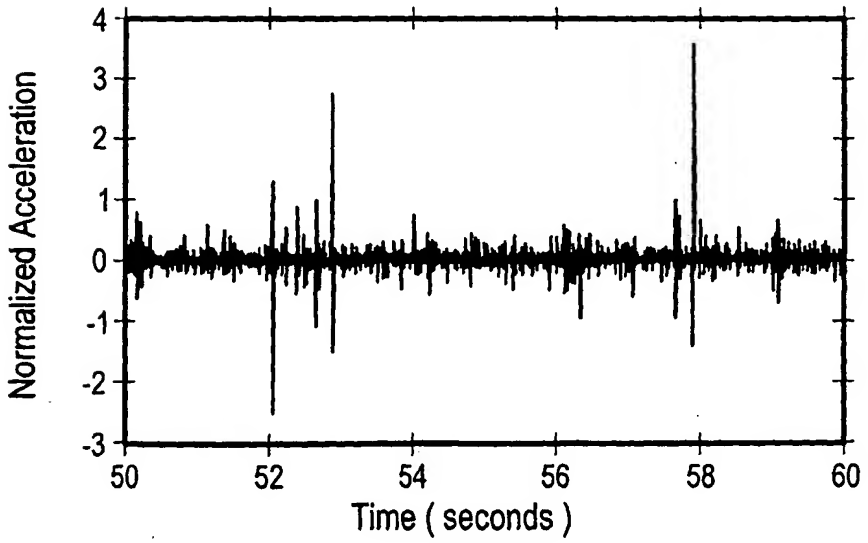
Normalized Acceleration
4
3
2
1
0
-1
-2
-3
50
52
54
56
58
60
Time (seconds)

Fig.3 8

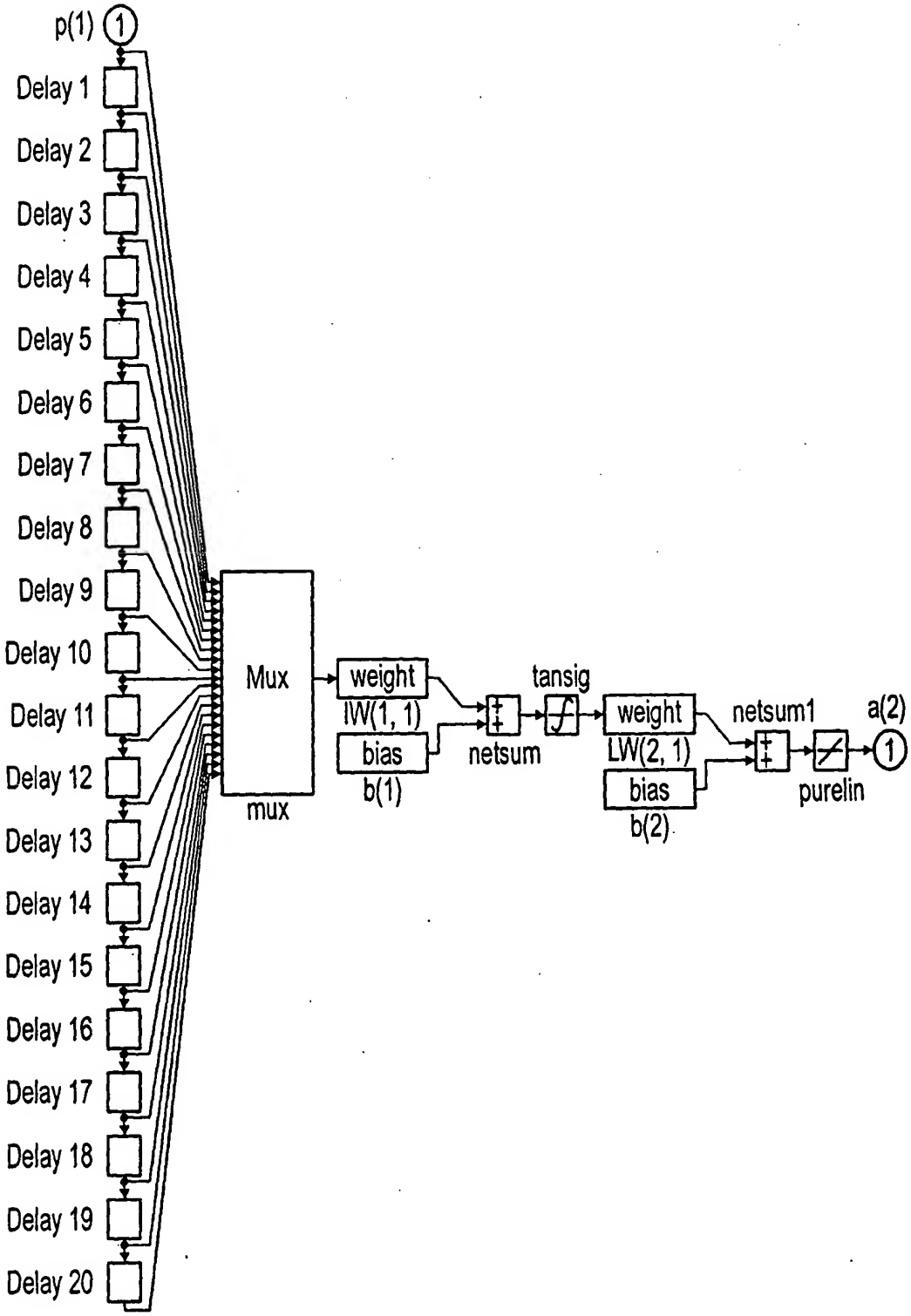
p(1)
1
Delay 1
Delay 2
Delay 3
Delay 4
Delay 5
Delay 6
Delay 7
Delay 8
Delay 9
Delay 10
Delay 11
Delay 12
Delay 13
Delay 14
Delay 15
Delay 16
Delay 17
Delay 18
Delay 19
Delay 20
Mux
mux
weight
IW(1, 1)
bias
b(1)
netsum
tansig
weight
LW(2, 1)
bias
b(2)
netsum1
purelin
a(2)
1

Fig. 37

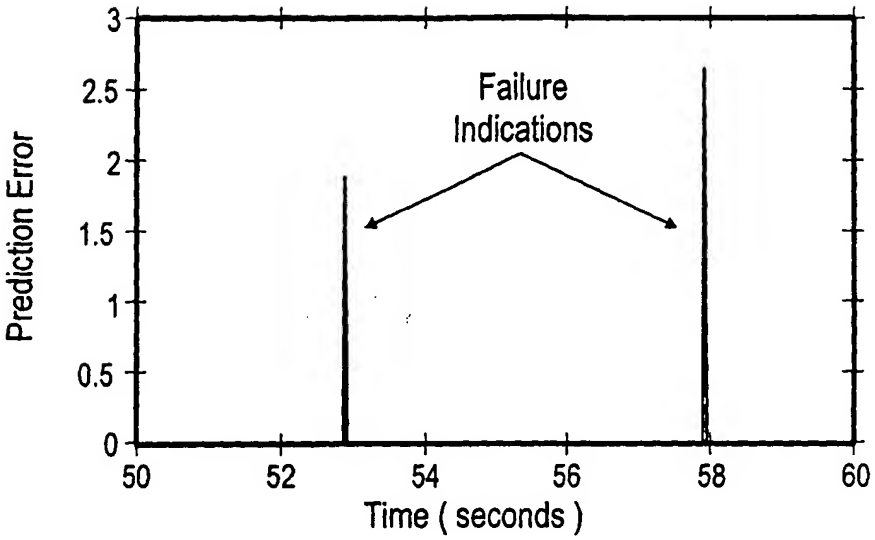
Prediction Error
Failure
Indications
3
2.5
2
1.5
1
0.5
0
50
52
54
56
58
60
Time (seconds)

Fig.3 9

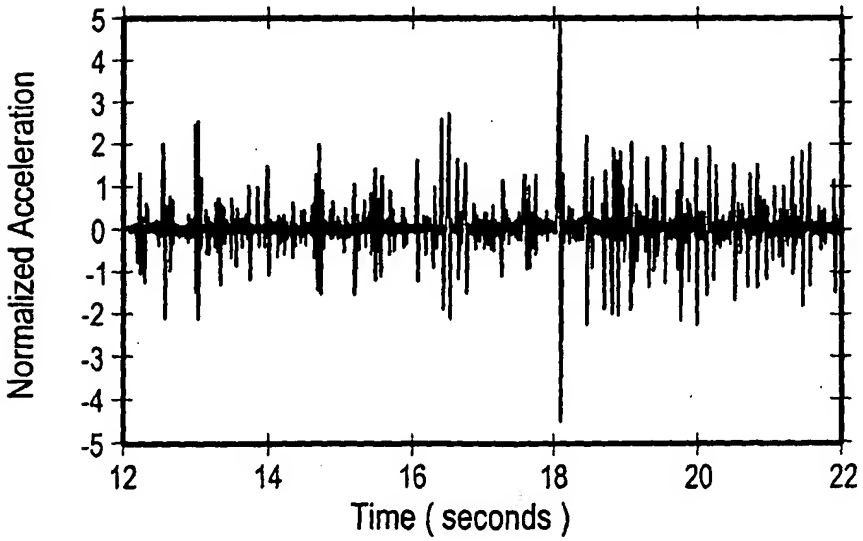
Normalized Acceleration
5
4
3
2
1
0
-1
-2
-3
-4
-5
12
14
16
18
20
22
Time (seconds)

Fig.4 0

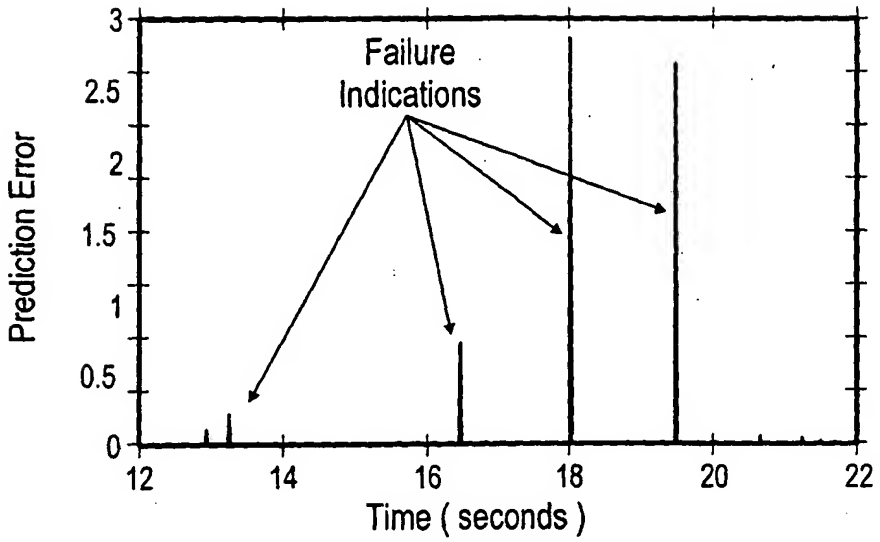
Failure
Indications
Prediction Error
3
2.5
2
1.5
1
0.5
0
12
14
16
18
20
22
Time (seconds)

Fig.4 1

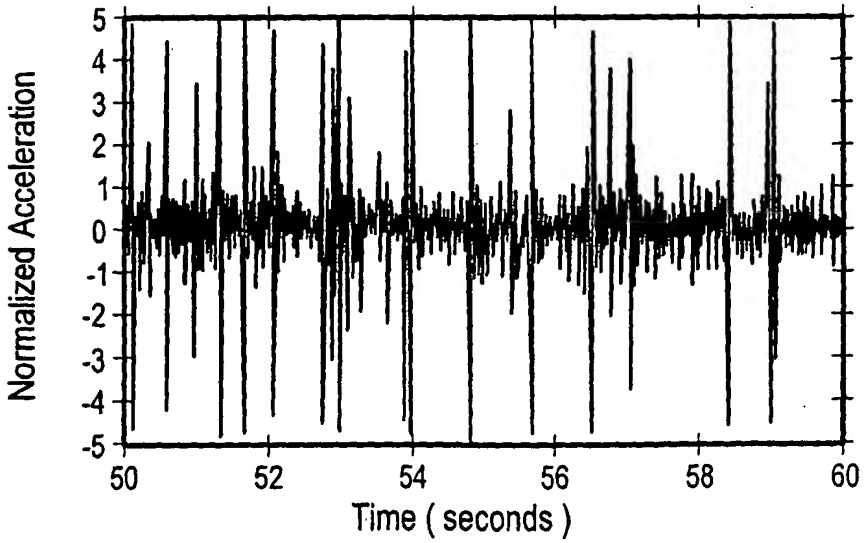
Normalized Acceleration
5
4
3
2
1
0
-1
-2
-3
-4
-5
50
52
54
56
58
60
Time (seconds)

Fig.4 2

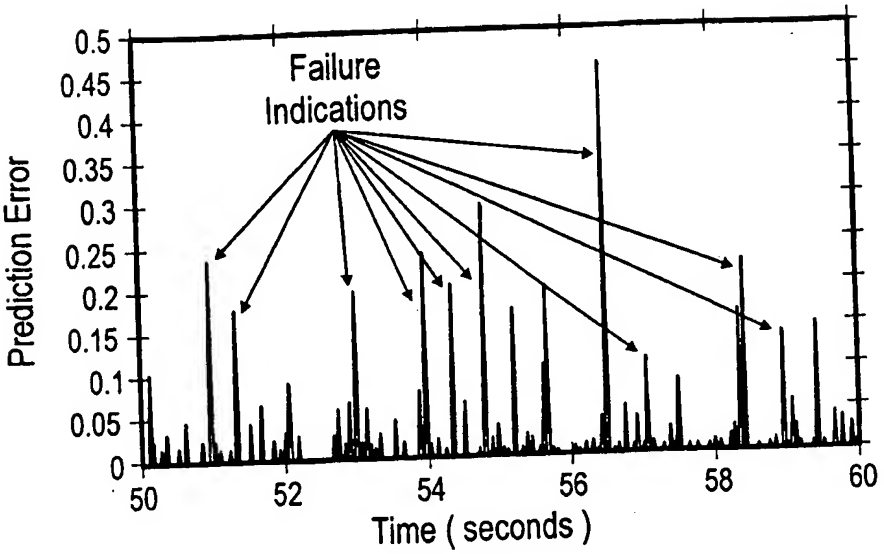
Failure
Indications
Prediction Error
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
50
52
54
56
58
60
Time (seconds)

Fig.4 3

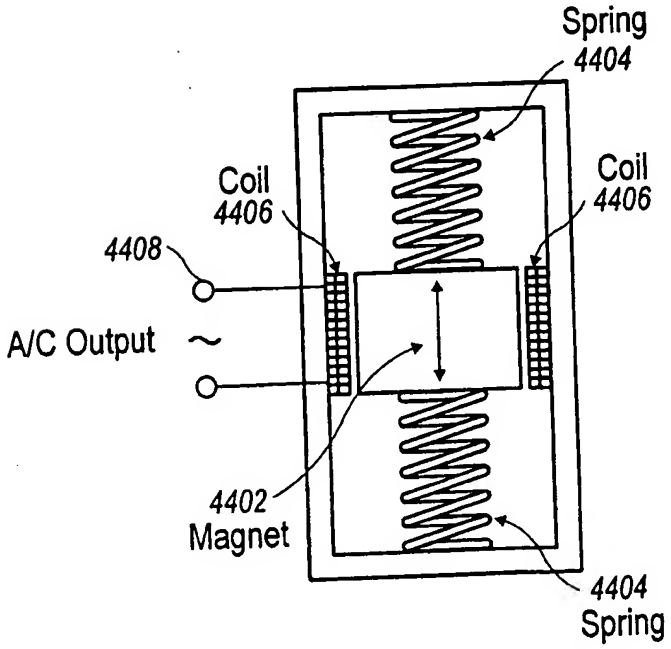
Spring
4404
Coil
4406
Coil
4406
4408
A/C Output
4402
Magnet
4404
Spring

Fig. 44

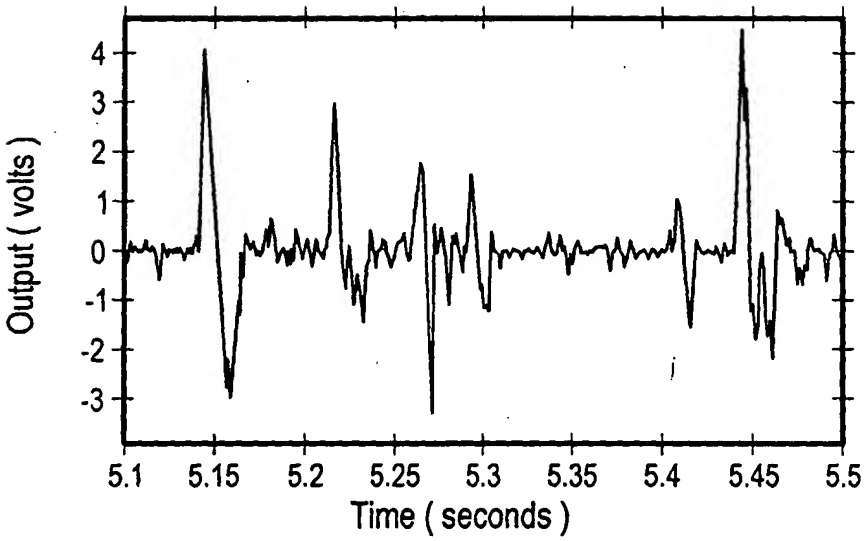
Output (volts)
4
3
2
1
0
-1
-2
-3
5.1
5.15
5.2
5.25
5.3
5.35
5.4
5.45
5.5
Time (seconds)

Fig.4 5

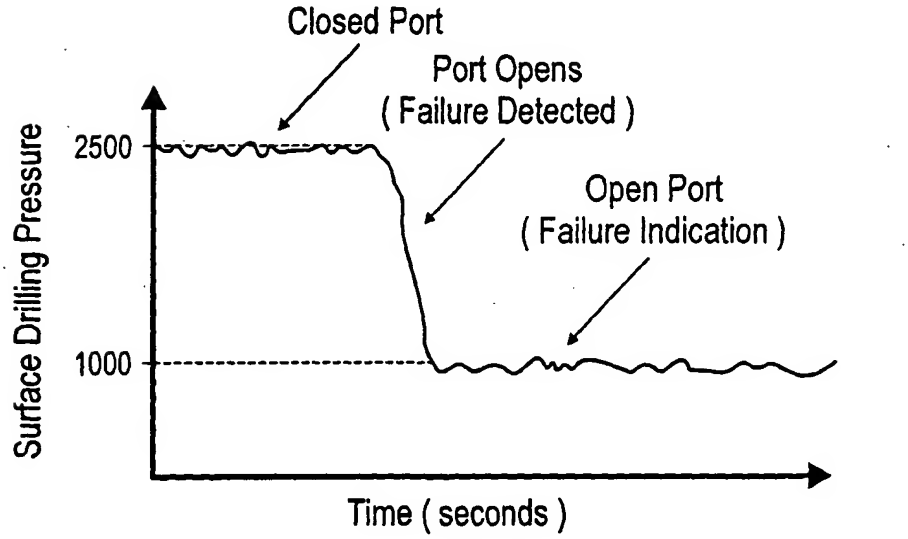
Closed Port
Port Opens
(Failure Detected)
Open Port
(Failure Indication)
Surface Drilling Pressure
2500
1000
Time (seconds)

Fig.4 6

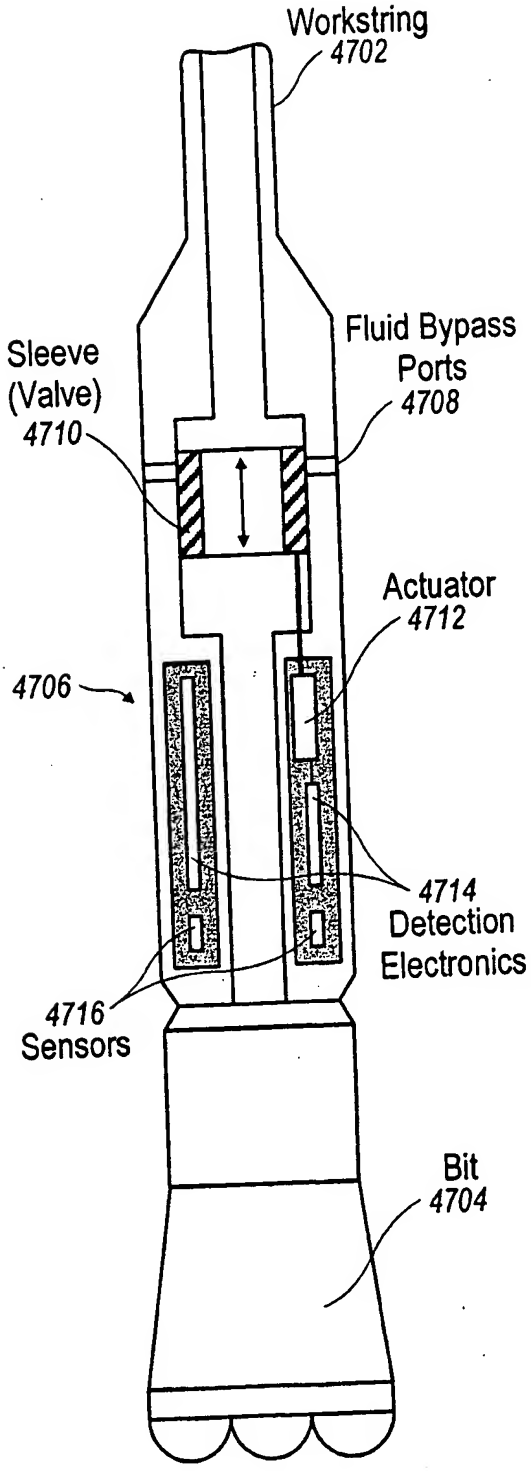
Workstring
4702
Fluid Bypass
Ports
4708
Sleeve
(Valve)
4710
Actuator
4712
4706
4714
Detection
Electronics
4716
Sensors
Bit
4704

Fig. 47

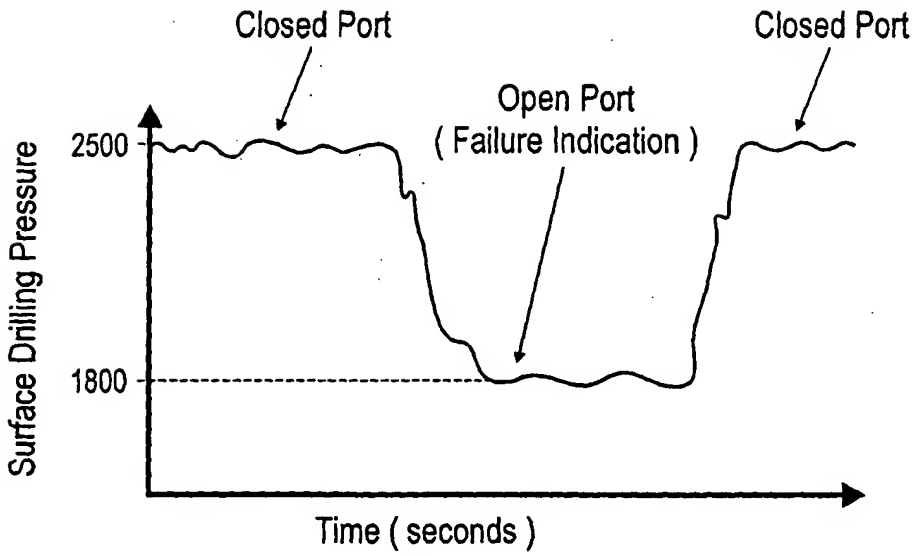
Closed Port
Closed Port
Open Port
(Failure Indication)
2500
1800
Surface Drilling Pressure
Time (seconds)

Fig.4 8

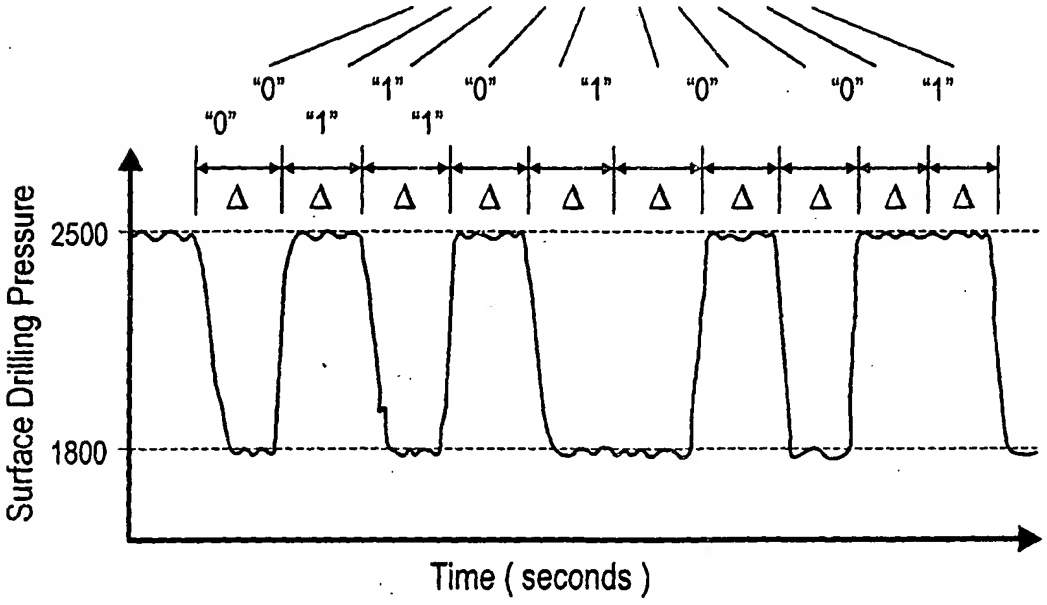
"0"
"1"
"0"
"1"
"0"
"0"
"1"
"0"
"1"
"1"
Δ
2500
1800
Surface Drilling Pressure
Time (seconds)

Fig.4 9

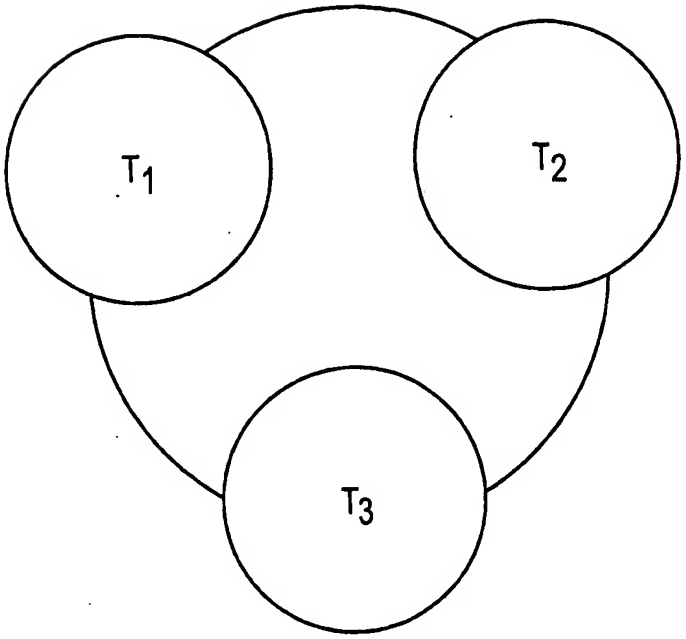

Fig. 50

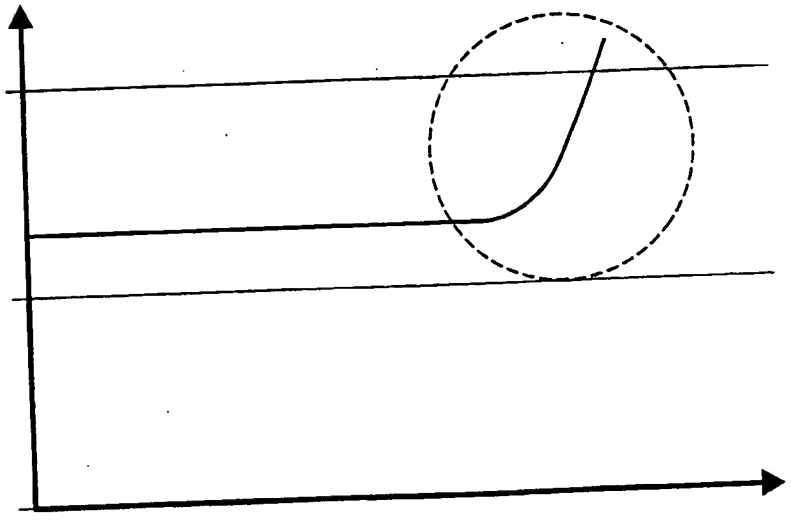

Fig. 51

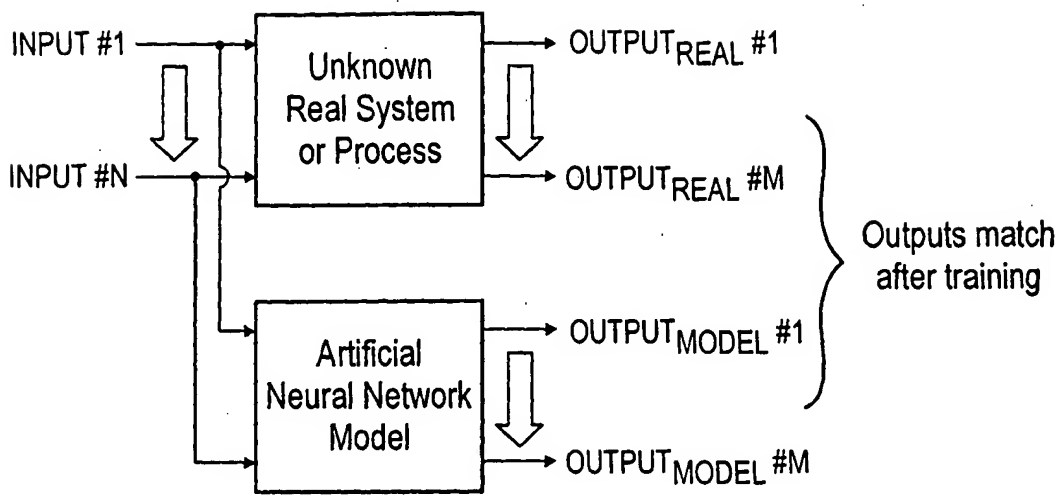
INPUT #1
INPUT #N
Unknown
Real System
or Process
OUTPUT REAL #1
OUTPUT REAL #M
Outputs match
after training
Artificial
Neural Network
Model
OUTPUT MODEL #1
OUTPUT MODEL #M

Fig.5 2

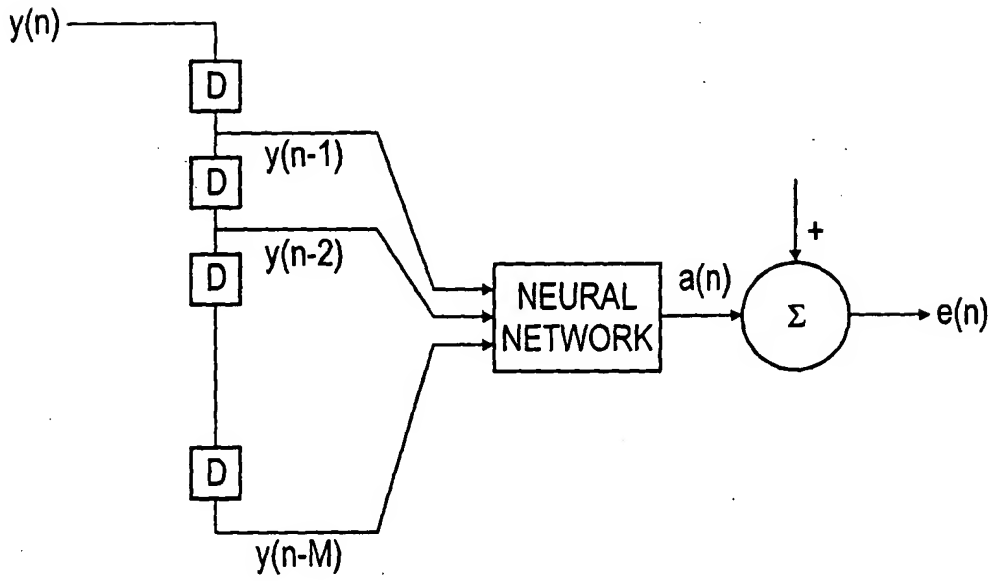
y(n)
D
D
D
D
y(n-1)
y(n-2)
y(n-M)
NEURAL
NETWORK
a(n)
+
Σ
e(n)

Fig.5 3

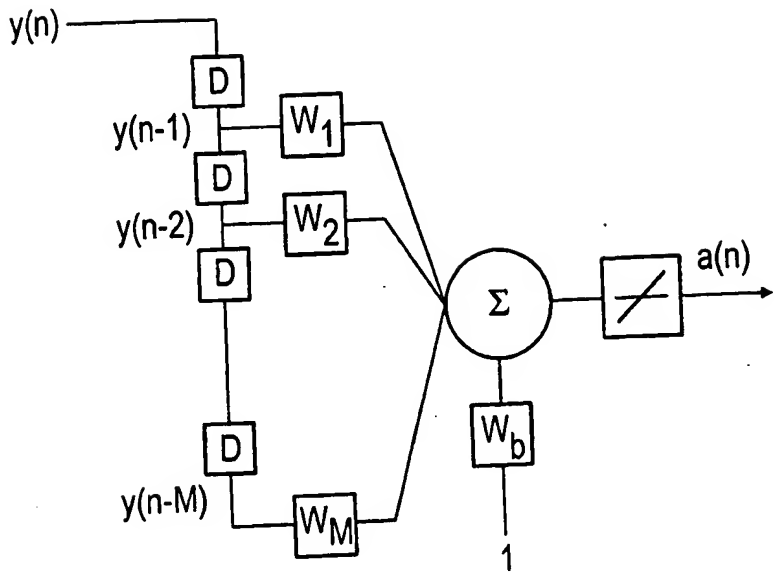
y(n)
D
y(n-1)
W1
D
y(n-2)
W2
D
D
y(n-M)
WM
Σ
a(n)
Wb
1

Fig.5 4

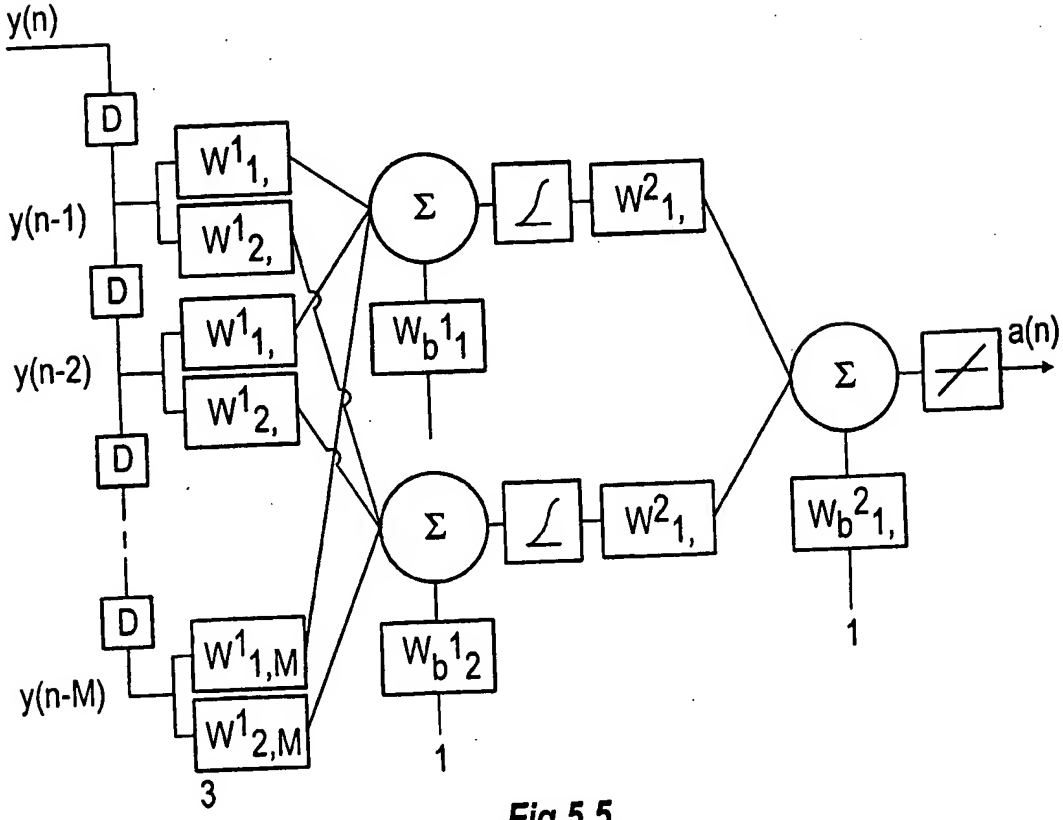
y(n)
D
y(n-1)
D
y(n-2)
D
D
y(n-M)
3
W1 1,
W1 2,
W1 1,
W1 2,
W1 1,M
W1 2,M
Σ
Σ
Wb1 1
Wb1 2
1
W2 1,
W2 1,
Σ
a(n)
Wb2 1,
1

Fig.5 5

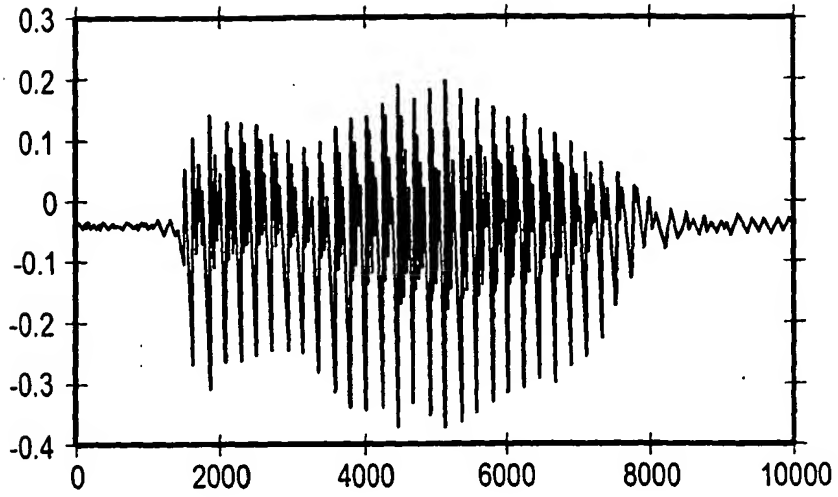

Fig.5 6

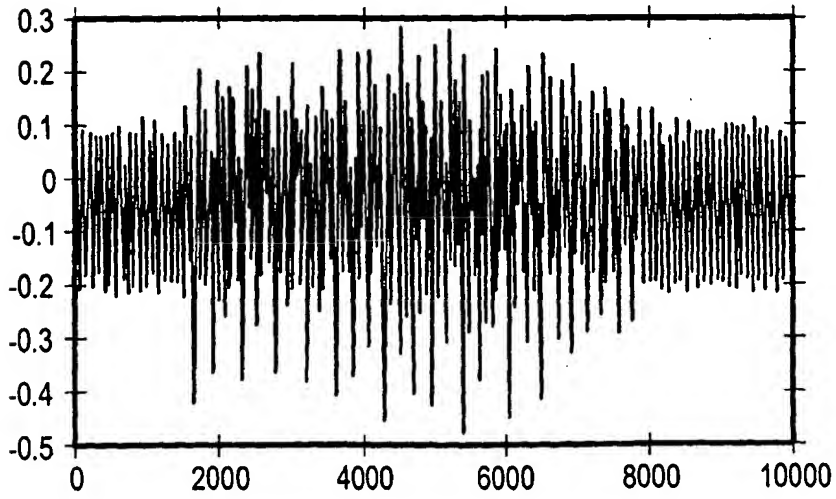

Fig.5 7a

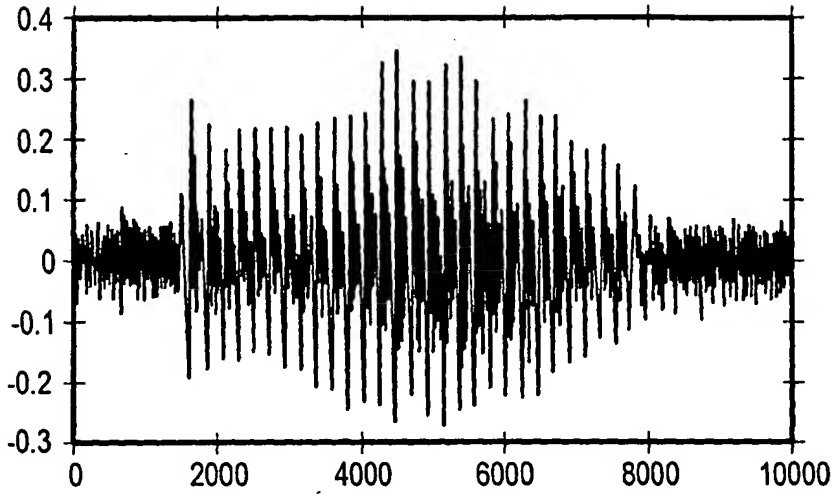

Fig. 57b

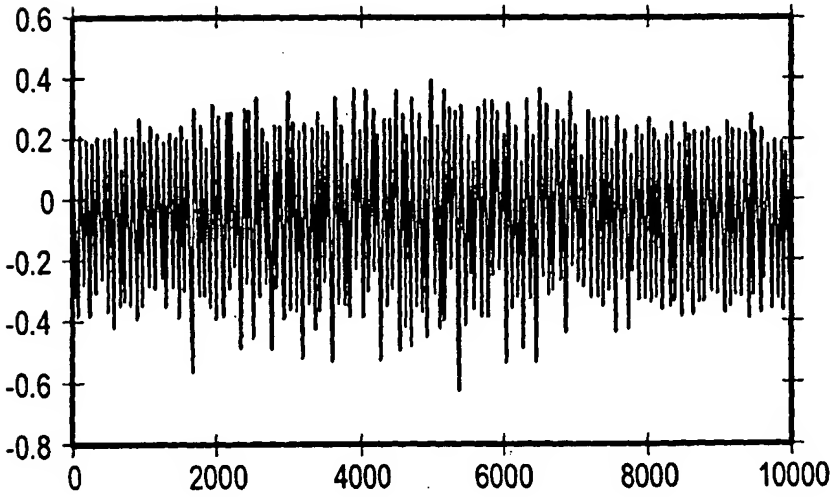

Fig.5 8a

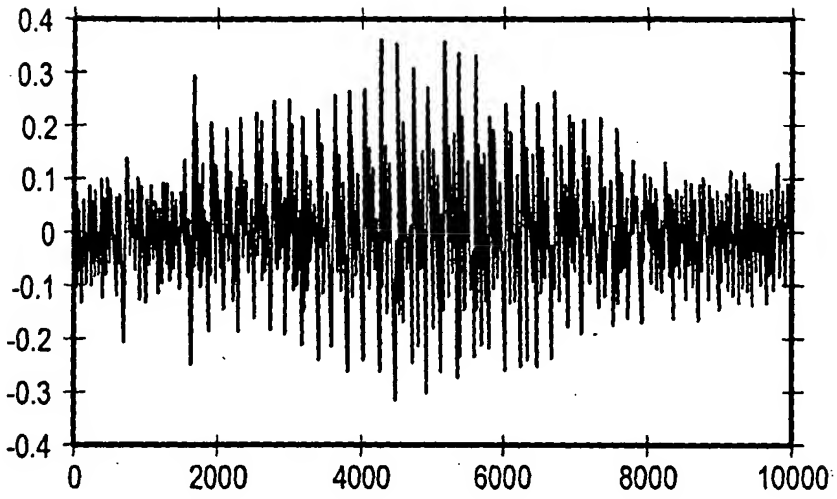

Fig. 58b

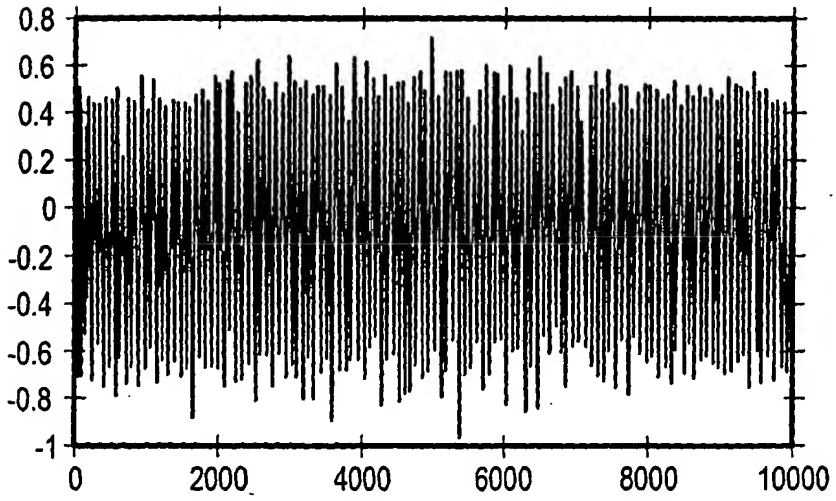

Fig.5 9a

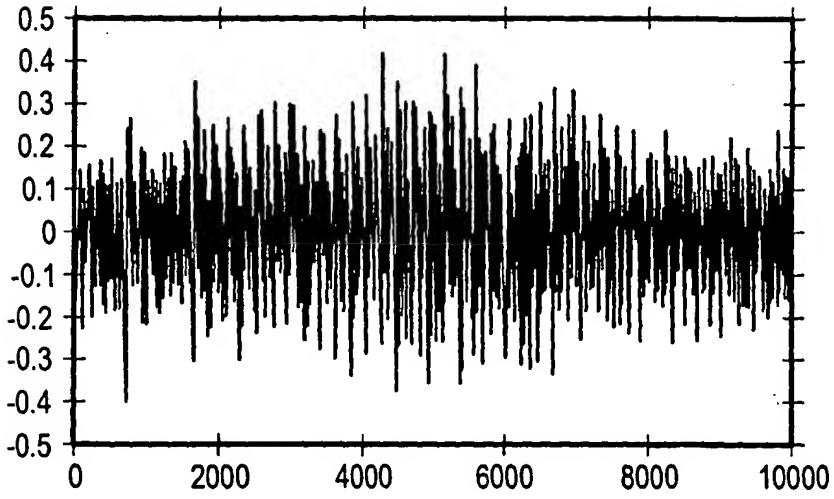

Fig. 59b

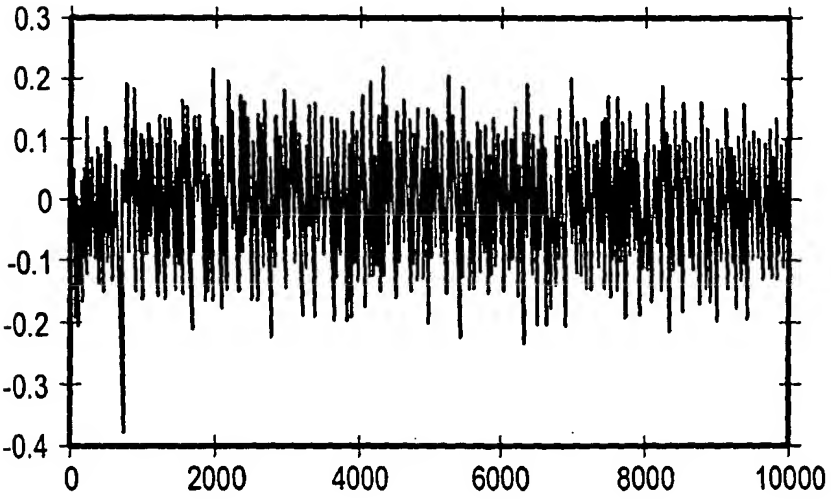

Fig.6 0

APPENDIX C – Copy of Notice of Appeal

PTO/SB/31 (09-04)
Approved for use through 07/31/2006. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

NOTICE OF APPEAL FROM THE EXAMINER TO THE BOARD OF PATENT APPEALS AND INTERFERENCES

Docket Number (Optional): SC-01-05

I hereby certify that this correspondence is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to "Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450" [37 CFR 1.8(a)]
on 12/20/2004
Signature Peggy Heath
Typed or printed name PEGGY HEATH

In re Application of: SCULTZ ET AL.
Application Number: 10/036,105 | Filed: 10/17/2001
For: Downhole Drill Bit Monitoring
Art Unit: 3672 | Examiner: Giovanna M. Collins

Applicant hereby appeals to the Board of Patent Appeals and Interferences from the last decision of the examiner.

The fee for this Notice of Appeal is (37 CFR 41.20(b)(1)) $ $500.00

☐ Applicant claims small entity status. See 37 CFR 1.27. Therefore, the fee shown above is reduced by half, and the resulting fee is: $

☐ A check in the amount of the fee is enclosed.

☐ Payment by credit card. Form PTO-2038 is attached.

☐ The Director has already been authorized to charge fees in this application to a Deposit Account. I have enclosed a duplicate copy of this sheet.

☒ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. 07-2320. I have enclosed a duplicate copy of this sheet.

☐ A petition for an extension of time under 37 CFR 1.136(a) (PTO/SB/22) is enclosed.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

I am the

☐ applicant/inventor.

☐ assignee of record of the entire interest. See 37 CFR 3.71. Statement under 37 CFR 3.73(b) is enclosed. (Form PTO/SB/96)

☒ attorney or agent of record. Registration number 49,042

☐ attorney or agent acting under 37 CFR 1.34. Registration number if acting under 37 CFR 1.34.

N. Elizabeth Pham
Signature
N. Elizabeth Pham
Typed or printed name
(972) 980-5840
Telephone number
December 14, 2004
Date

NOTE: Signatures of all the inventors or assignees of record of the entire interest or their representative(s) are required. Submit multiple forms if more than one signature is required, see below*.

☒ *Total of 2 forms are submitted.